BRITISH RAILWAY TRACK

FLAT BOTTOM TRACK SUPPLEMENT

DESIGN
CONSTRUCTION AND MAINTENANCE

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SUPPLEMENT

DESIGN, CONSTRUCTION
AND MAINTENANCE

BY

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PART I

FLAT BOTTOM TRACK — PLAIN LINE

HISTORICAL

The experiments with Flat Bottom rails which were carried out in this country between the years 1936 and 1940 (British Railway Track—Chapter 2) were continued on a much wider scale during the War years. The American 131-lb. section was discarded as being an uneconomical rail for use here. It was a very stiff rail and trouble was experienced with rail end batter. Furthermore the rail offered no advantages to warrant the use of such a large amount of steel.

The B.S. 110-lb. rail was rather more suited to our conditions but was not considered to be an ideal section. Originally designed for use directly on the sleepers, the 6″ width of foot is somewhat more than is necessary when the rails are carried by baseplates. The upper and lower fishing tables of the rail differ rather widely in angle of inclination, with the result that the wear on the corresponding fishing surfaces of the fishplates is unequal and the plates soon pull in at the bottom.

A new rail section with a weight of 113-lb. per yard was then designed in order to overcome these deficiencies. This rail was widely used for both plain track and switches and crossings in fast main lines in this country.

Soon after the nationalisation of British Railways in 1948 the decision was taken to change over from Bull Head to Flat Bottom rails for general use in this country. The Civil Engineers' Committee were of the opinion that traffic demands on Main Lines, where ultra-high speed trains ran in pre-war years, were more than Bull Head rails would stand without excessive maintenance costs, and since the extensive trials with Flat Bottom track had definitely proved that a saving in maintenance could be achieved by the use of the stiffer rails, the change in policy was agreed.

It was decided not to use any of the F.B. rail sections which had been on trial, but to introduce two entirely new sections

as the new standards. A heavy rail with a weight of 109 lb. per yard to replace the 95 R.B.S. Bull Head section, and a lighter rail of 98 lb. per yard in place of the 85 R.B.S. section.

DESIGN OF RAILS AND FISHPLATES.

The main features of the design of the 109 lb. rail (Fig. 1) are as follows :—

(1) The size of the head of the 95 lb. B.H. rail had proved to be satisfactory in withstanding maximum loads without mushrooming out and also from the point of view of wear. This size was therefore adopted for the F.B. rail but the radius of the top of the head was made 9″ instead of 12″ as the former dimension was found to be the average radius of all worn rail heads in this country. This feature ensures good running in the very early life of the track, whereas previously rails with a head radius of 12″ required a " running-in " period of from 6 to 12 months before smooth riding was achieved.

(2) The width of foot has to be sufficient to give good lateral rigidity, but if too wide is very wasteful in metal. A width of $5\frac{1}{2}$″ was found to be satisfactory. The thickness of the extreme edges of the foot is very critical, as it must be sufficient to resist rapid wear against the baseplate shoulders, particularly when reduced in thickness by corrosion. A thickness of $\frac{3}{8}$″ was adopted, being based on previous experience.

(3) The upper and lower fishing angles should be of equal inclination in order to maintain uniform wear, and furthermore this inclination should be fairly steep so that the tightening of the fishbolt nuts does not produce too great a stress in the web of the rail. An inclination of 1 in $2\frac{3}{4}$ was adopted as this angle had been found satisfactory in the case of 95 lb. B.H. rails. When however this angle is used for the lower fishing table of a F.B. rail with the thickness of the edge of the foot $\frac{3}{8}$″, there is a very large amount of metal concentrated in the foot. A double angle foot was therefore used for the 109 lb. rail with a resultant saving in metal without much loss in strength.

(4) The minimum thickness of the web was made $\frac{5}{8}$″, this figure being sufficient to withstand the stresses which are known to occur, allowing also for normal corrosion. The web was curved so that it gradually thickened as it approached the head and foot, being finally joined

to those parts of the section by the use of fillets of fairly large radius. This provides a maximum amount of metal just under the head and above the foot, a very important feature in reducing stresses in these areas which are the source of many rail end failures.

(5) The height of the rail controls its strength and rigidity as a beam, and in the case of the 109 lb. rail a dimension of $6\frac{1}{4}''$ was found to give a sufficient increase in the strength with economy in use of metal.

The 98 lb. rail (Fig. 1) was designed in a similar way, the reduction in weight being achieved in the following way :—

(1) Depth of head reduced by $\frac{1}{8}''$.
(2) Web thickness reduced by $\frac{1}{16}''$.
(3) Edge of foot thickness reduced by $\frac{1}{32}''$.
(4) Height reduced from $6\frac{1}{4}''$ to $5\frac{5}{8}''$.

The width of the foot was not reduced and the rail can thus be used on baseplates designed primarily for the 109 lb. rail.

It will be seen from Fig. 1 that the fishplates, particularly those for the 109 lb. rail, are not at all like those for 95 lb. B.H. rails. This is because the fishplates were designed to give the highest ratio of strength of plates to strength of rail. In order to make the fishplate strong when considered as a beam, it is necessary to concentrate as much metal as possible at the extreme top and bottom of the section, and to use a minimum of metal at the centre where the stresses are low. At the top of the section allowance has to be made to give clearance to the flange of a worn locomotive tyre running on the worn head of the rail, and this naturally limits the amount of metal which can be concentrated in that area. There is also another important point to be considered when deciding how much metal should be concentrated at the upper and lower limits of the fishplate section, and that is the all important one of trying to reduce the number of fishplate failures. When fishplates break, the crack usually starts on the topmost edge of the plate and gradually runs down the section, in many cases through a fishbolt hole. For this reason the metal in the 109 lb. fishplate was so arranged that the neutral axis of the plate was rather nearer the top than the bottom and this means that when a vertical load causes the fishplate to bend, the stresses at the top are lower than those at the bottom.

In the table below, the chief characteristics of the 109 lb. and 98 lb. rails and fishplates are shewn alongside those of the 95 lb. B.H. rail and fishplate.

	109lb. F.B.	98 lb. F.B.	95 lb. B.H.
RAILS.			
Moment of Inertia XX ..	55·9 ins.^{4}	40·8 ins.^{4}	35·1 ins.^{4}
„ „ „ YY ..	9·67 ins.^{4}	8·78 ins.^{4}	4·09 ins.^{4}
Section Modulus—Top ..	16·89 ins.^{3}	13·77 ins.^{3}	13·12 ins.^{3}
„ „ —Bottom ..	19·02 ins.^{3}	15·30 ins.^{3}	11·53 ins.^{3}
FISHPLATES (PAIR)			
Moment of Inertia XX ..	13·74 ins.^{4}	8·76 ins.^{4}	5·76 ins.^{4}
Section Modulus—Top ..	6·65 ins.^{3}	4·72 ins.^{3}	3·29 ins.^{3}
„ „ —Bottom ..	6·46 ins.^{3}	4·73 ins.^{3}	3·29 ins.^{3}
Weight (holed)	54·58 lb.	44·29 lb.	32·25 lb.
Ratio $\frac{I_{xx} \text{ Fishplates}}{I_{xx} \text{ Rail}}$	24·6%	21·5%	16·4%

The standard fishbolt which is used with either the 109 lb. or the 98 lb. rail is also shewn in Fig. 1 and is seen to have a pan-shaped head and the usual pear-shaped neck. The bolt is 1″ diameter and has a B.S.F. thread. The special steel washer, which has a thickness of $\frac{1}{4}$″, is necessary when the fishbolt is used with the 109 lb. fishplate, to enable the nut to clear the rib on the outside face of the plate. The 98 lb. fishplate has no such rib and the washer may therefore be dispensed with.

JUNCTION AND INSULATED FISHPLATES

When Flat Bottom rails are to be joined up to Bull Head rails or alternatively to Flat Bottom rails of different section, it is necessary to use "junction fishplates". Two types of plate are available, one being drop-forged and the other machined from steel plate. Fig. 2 shews the two designs in elevation.

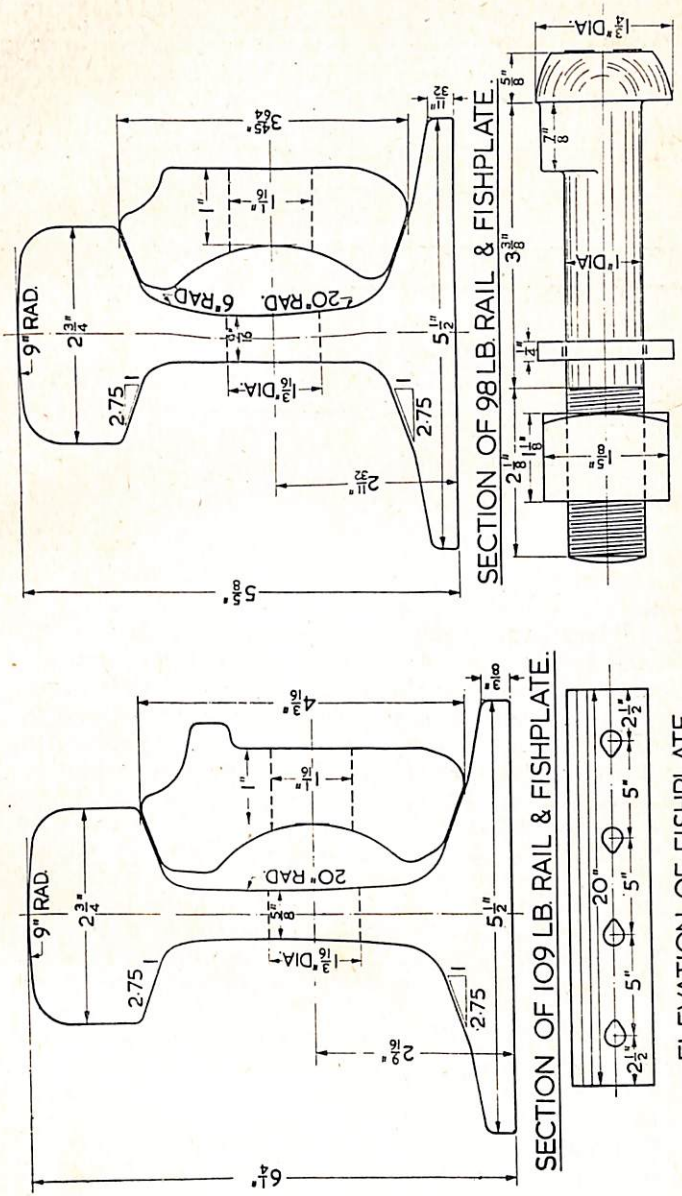
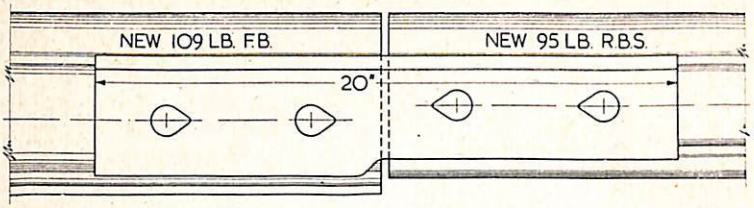
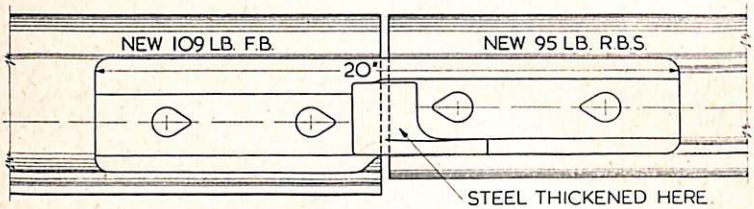

SECTION OF 98 LB. RAIL & FISHPLATE.
SECTION OF 109 LB. RAIL & FISHPLATE.
ELEVATION OF FISHPLATE.
FISHBOLT & NUT.
9" RAD.
20" RAD.
6" RAD.
2.75
20"
5"
5"
2½"
2½"

FIG. I.



MACHINED JUNCTION FISHPLATE.



FORGED JUNCTION FISHPLATE.

FIG. 2.

It will be seen from Fig. 2 that where the change in section from the deep portion of the plate to the shallower portion occurs, the lower edge of the plate is not allowed to have very sharp bends in it, because such corners are usually the origin of cracks which develop under traffic conditions. One of the main features of the drop-forged plate is the thickening of the steel at the centre, thus strengthening the plate at the point where the biggest stresses occur. A very wide range of junction fishplates is manufactured for use with new and worn rails of all the usual sections which occur in practice. It should be noted however that junction fishplates for use with two rail sections having the same width of head are supplied in pairs, whereas those for use with rails having different head widths are usually in sets of four plates.

Insulated fishplates are of course required for Flat Bottom Track where track circuits occur and the type most frequently used are the proprietary articles known as "Permali Fishplates". These plates are made from compressed, bakelite impregnated, wood laminations and are of course, rather thicker than ordinary steel fishplates. Pieces of insulating material called "end posts" are inserted between the two rail ends, and are approximately the same shape as the rails.

PLAIN TRACK BASEPLATES AND FASTENINGS

The term " chair " used in the case of Bull Head track is replaced by the description " baseplate " when Flat Bottom rails are considered. The latter term is very appropriate as the baseplate forms a bearing for the foot of the rail and also serves to spread the load over a much larger area of the sleeper than would the rail foot alone were it placed directly on the sleeper.

In the case of Bull Head track, where the rails are keyed into the chairs, the question of fastenings is fairly easily settled, the choice lying between chair screws or bolts, but for Flat Bottom rails the position is very different. The fastenings have two duties to perform, first to hold the rail in contact with the baseplate and secondly, to hold the baseplate to the sleeper. The three most common methods in use at the present time are as follows :—

(1) The American method in which the rails are placed on steel baseplates, and square spikes with large heads which slightly overhang the edge of the rail foot, serve to hold the rail to baseplate and baseplate to sleeper. In this method, the wave motion of the rail under traffic tends to raise the spikes slightly, and as the pressure on the rail foot is thus reduced, it is essential to fit rail anchors in order to prevent extensive rail creep.

(2) Rigid or spring steel clips with suitable bolts to hold the rail to baseplate, and screws to hold the baseplate to sleeper. This method provides an excellent grip on the rail foot when the nuts of the clip bolts are tight and so prevents creep, and also allows the renewal of rails to be carried out without disturbing the baseplates. A disadvantage lies in the increased maintenance necessary in keeping a large number of nuts and screws tight.

(3) Spring spikes to perform the double duty of holding rail to baseplate and baseplate to sleeper. This type of fastening, if correctly maintained, ensures a good grip on the rail foot, and any movement due to the wave motion of the rail is absorbed by the specially shaped head of the spike thus enabling the shank to maintain its hold in the sleeper. This assembly requires the least number of components and has good resistance to rail creep.

On British Railways method (3) has been adopted for most plain track, and method (2) with spring steel clips for switches and crossings.

The spring spike most generally used for plain track is the proprietary Elastic Rail Spike, already referred to in "British Railway Track—Chapter 2". The spike is made of silico-manganese spring steel and galvanised, and the $\frac{5}{8}$" square shank is driven into pre-bored holes in the sleepers. In the case of softwood sleepers the holes are $\frac{1}{2}$" diameter and drilled right through the sleepers to make sure the spike shank is not stopped before the full tension is put on the rail foot.

An alternative type of spring spike is the proprietary "Macbeth" spike. This spike is made from solid round steel bar $\frac{3}{16}$" diameter and has two shanks which are driven into $\frac{7}{16}$" diameter pre-bored holes in softwood sleepers. The general shape of the spike may be seen in Fig. 3.

Up to the present time, four designs for plain track baseplates have been standardised (see Fig. 3) and brief descriptions are given below.

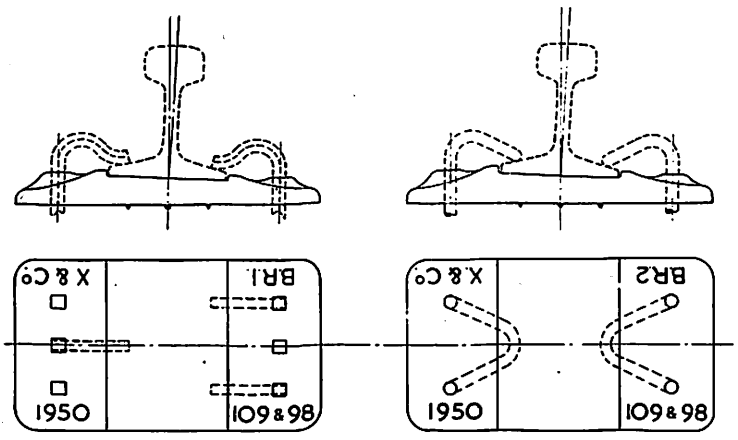
(*a*) The B.R.1 baseplate is made of cast iron, and is provided with square holes for the Elastic Rail Spikes. It will be seen from the illustrations that six spike holes are provided but only three are used in the first instance. The extra holes are to enable additional spikes to be used if rail creep occurs, or alternatively to allow for a change in position of the spikes should they lose their grip in the timber when splits develop.

(*b*) The B.R.1.S. baseplate is the rolled steel counterpart of the B.R.1.

(*c*) The B.R.2. baseplate is also of cast iron, similar in shape to the B.R.1. but provided with four round holes to suit the Macbeth spikes.

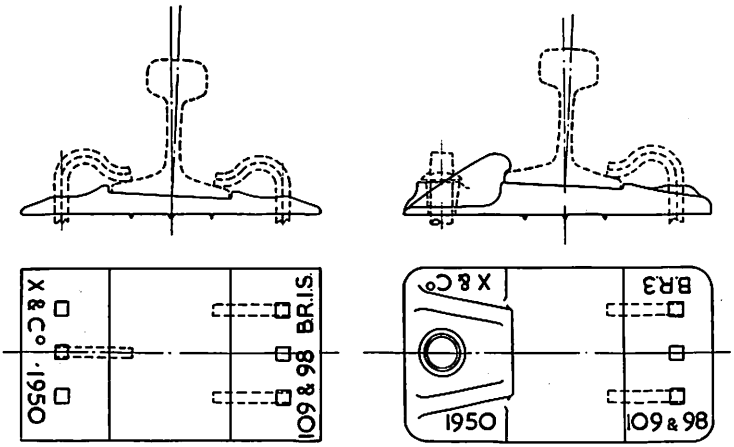
(*d*) The B.R.3. or "Apron" type baseplate is made of cast iron, and has an overhanging lip on the outside of the rail foot and three square spike holes on the inside. A standard chair screw is used for holding down the baseplate on the outside of the rail and usually two Elastic Rail Spikes on the inside.

All the baseplates have inclined rail seatings, in order to provide the usual 1 in 20 inclination of the rail. Another feature common to all these plain track baseplates is the provision of small nibs on the underside, immediately beneath the rail seating. The nibs sink into the surface of the sleepers after the passage of a few trains and then materially assist in preventing spread of gauge.



C.I. BASEPLATE TYPE B.R.1.

C.I. BASEPLATE TYPE B.R.2.



STEEL BASEPLATE TYPE B.R.1.S.

C.I. BASEPLATE TYPE B.R.3.

FIG. 3

The rail seating of each cast iron baseplate is slightly cambered longitudinally, so that a rail is normally bearing only on the centre portion of the seating. When a locomotive wheel reaches a point on a rail midway between two consecutive baseplates, the rail bends slightly under the load and the camber on the rail seatings allows this bending to take place without causing the baseplates to rock towards the bend. In other words the wave motion of a rail under traffic can take place without imparting a rocking motion to the baseplates and sleepers.

It will be seen from Fig. 3 that the baseplates carry identification markings which give details of the baseplate type (e.g. B.R.1), the weights of the rails for which they are designed, the manufacturer's initials and the year of manufacture.

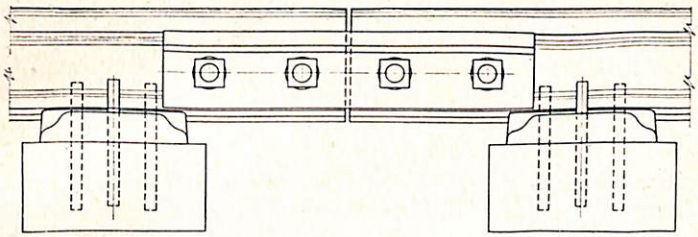
RAIL JOINTS

The fishplated joints of the Flat Bottom rails are of course very much stronger than those of the Bull Head rails due to the greater rigidity of the rails themselves and also to the greatly increased strength of the fishplates, and this feature enables certain changes to be made in the general arrangements. The practice of using 12″ x 5″ sleepers at the joints is no longer necessary as the stiffer rails are more effective in spreading the load to adjoining sleepers and for a similar reason wider joint baseplates need not be provided.

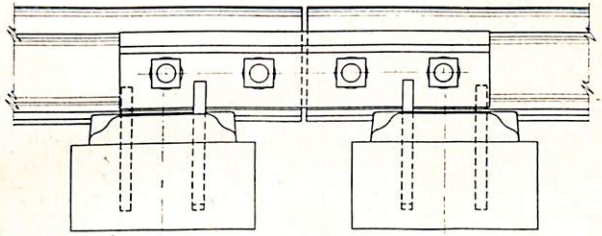
Two joint arrangements are recommended for Flat Bottom Track and these are illustrated in Fig. 4.

(1) The suspended joint is the most frequently used and is of course the equivalent of the usual Bull Head track joint. The two joint sleepers (so called because of their proximity to the joint and not to suggest that they are different in size from the other sleepers) are so placed that the spike fastenings just clear the ends of the fishplates.

(2) The semi-supported joint is very useful where even greater rigidity is required than that already achieved by the use of Flat Bottom rails. For example, in wet tunnels or on very soft formations, the hammer blow at the joints makes it very difficult to keep the joint sleepers well packed, and a very stiff joint arrangement is most desirable. With this type of joint a special Elastic Rail Spike is used because with the normal design, the toe of the spike would foul the fishplate. Furthermore it will be observed that the



SUSPENDED JOINT.



SEMI - SUPPORTED JOINT.

FIG. 4.

outside spikes are not driven through the central holes in the baseplates, but are located in the holes nearest to the joint, this enabling them to be driven to the correct tension without the risk of the hammer causing damage to the fishbolts and nuts.

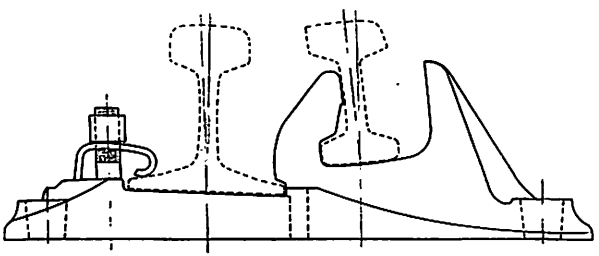
The expansion gaps to be allowed between rail ends are the same as those for Bull Head rails and are given in the table below :—

Rail Temperature	General Weather Description	Expansion Gap for 60-Ft. Rails
Below 50°F	Frosty or Cold	3/8″
50° — 75°F	Cold to Warm	1/4″
75° — 100°F	Hot	1/8″
Over 100°F	Very Hot	Nil

Although weather descriptions are given in the table, they should not be used if rail thermometers are available, as the latter provide the only really reliable method of deciding the correct gaps to adopt.

CHECK RAILS IN PLAIN TRACK

On curves with a radius of 10 chains or less, it is necessary to provide a check rail fitted to the inside rail, and with Flat Bottom track this is a little more complicated than with Bull Head track. When two F.B. rails, each having a $5\frac{1}{2}$" foot width, are to be placed sufficiently close to each other to give a flangeway clearance of $1\frac{3}{4}$" or 2", it is necessary to cut away part of the foot of the check rail. This is a costly operation for very long checks, and furthermore it is not an economical proposition to use heavy F.B. rails as check rails. One method of overcoming this difficulty is to use a serviceable B.H. rail as a check with a F.B. running rail, the two rails being held in a special combined baseplate and chair. (Fig. 5).



CHECK CHAIR FOR CURVES WITH B.H. CHECK RAIL.

FIG. 5.

An alternative method which is most likely to be used in the future is the adoption of a special rolled steel section designed purely for use as a check rail. This method is very economical in the use of steel as it is possible to design a very good section with a weight of about 70 lb. per yard.

SLEEPERS

The changeover to Flat Bottom track in this country has not affected the general policy with regard to the type of sleepers to be used for running lines. Softwood sleepers such

as Douglas Fir and Baltic Redwood are still the first choice for main lines, the sleepers being creosoted or treated with water soluble salts.

Concrete sleepers have been developed during the last few years for use in running lines, the pre-stressed variety proving to be the most satisfactory. Large numbers of such sleepers have been used with Bull Head rails in branch lines, goods lines and sidings. The new 109 lb. and 98 lb. Flat Bottom rails have not yet been laid on concrete sleepers, but suitable baseplates will shortly be designed to enable this to be done.

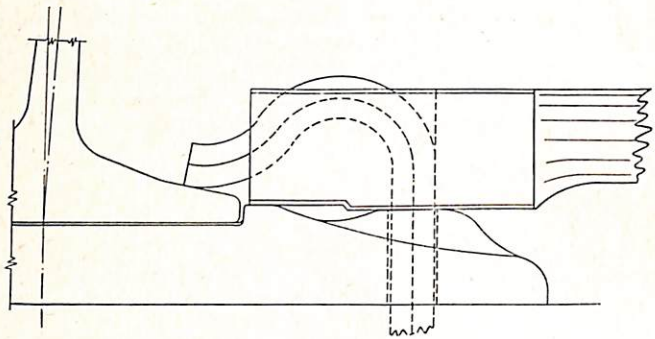
RENEWAL OF TRACK

Relaying methods in the case of Flat Bottom track are essentially the same as those for Bull Head track (see British Railway Track—Chapter 5) but there are several important considerations.

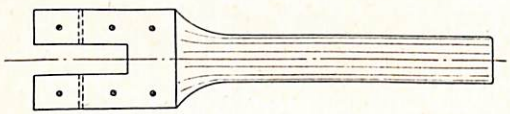
The Flat Bottom rail is very much stronger than the Bull Head rail, both vertically and laterally, but this does not mean that it can be more roughly handled. On the contrary, great care must be taken when loading or unloading the rails to prevent them from dropping, either individually or one on top of another. Such misuse causes crippled rail ends which cannot easily be rectified, and there is a danger of slightly bending the rail foot. Both defects lead to bad maintenance and possible rail failure.

When the lumping method is used for relaying, the rails are best handled by means of rail tongs or by trestles. The baseplates will have been positioned on the sleepers by the insertion of the inside spikes, the latter being only partly driven. Care must be taken to brush any small stones off the rail seatings of the baseplates and the rails can then be swung under the toes of the inside spikes and lowered gently on to the baseplates. The outside spikes are put in and all spikes driven down to contact the rail foot. After two or three trains have passed over the new track at slow speed, the baseplate nibs will have bedded into the sleepers, and all the spikes must then be correctly tensioned in order to prevent rail creep in the first few weeks in the life of the new track. A simple form of gauge, commonly referred to as a " hambone gauge ", is illustrated in Fig. 6. The gauge is shewn in position, and it will be seen that the head of the spike projects above the top surface. The spike is correctly tensioned when it is driven down so that the head is flush with the top of the gauge. After about three weeks the new rails will have

become bedded down on the sleepers with the result that some of the spike tension will have been lost. Every spike must then be correctly re-tensioned, using the gauges.



GAUGING OF ELASTIC SPIKES



PLAN OF HARDWOOD GAUGE

FIG. 6

The importance of carrying out the double tensioning of the spikes as described above cannot be too strongly emphasised. Poor tensioning of spikes leads to rail creep, and then the spikes have to be partially withdrawn, rails pulled back and spikes re-driven. Repetitions of this procedure weaken the hold of the spikes in the timber.

The laying of pre-assembled 60-ft. lengths of track is a relaying method which is now very extensively used. The lengths of track are assembled at a convenient depot, loaded by crane, one on top of another to a maximum of six lengths on each long rail wagon, and conveyed to the relaying site. The old track is lifted out in complete lengths by crane, loaded on rail wagons, and the new track lowered into position. An important point in the case of Flat Bottom track is that the spikes are usually driven into contact with the rail foot at

the pre-assembly depot, but are not tensioned. After the track has been laid, correctly aligned and ballasted, the spikes must be tensioned as previously described.

GENERAL MAINTENANCE

Maintenance methods for Flat Bottom track follow the same general lines as those for Bull Head track (British Railway Track—Chapter 4), subject of course to the essential difference in fastenings i.e. baseplates and spikes in lieu of chairs, keys and screws or bolts.

Wear on the contact surfaces of fishplates calls for the use of suitable shims to prevent the plates drawing in to the webs of the rails, in which position they no longer give correct support to the rail ends. Full shims and half shims, of the parallel or tapered varieties, are available for F.B. rails.

Should rail creep occur, even when the spikes are correctly tensioned, rail anchors should be fitted, the number varying from 8 to 12 to each 60-ft. rail according to the severity of the creep.

Oil boxes may be fitted to F.B. rails on curves in the usual way, care being taken when ordering to state the weight and type of rail for which they are required.

Finally it is true to say that Flat Bottom track correctly laid, properly packed, well ballasted and efficiently spiked, will provide an excellent road and produce a saving in subsequent maintenance, but if incorrectly installed will have no advantage to offer.

PART II

SWITCHES & CROSSINGS

GENERAL REMARKS

Switches and crossings are now being made in 109-lb. material and some of the main features of the designs are as follows :—

(1) All the baseplates are cast iron and are fastened to the switch and crossing timbers by galvanised chair screws as in the case of Bull Head chairs. Wood ferrules are used in the screw holes, and there are four screws to all baseplates except the short STO and STN types, which have two. The timbers are almost always 12″ wide by 6″ deep.

(2) All baseplates except the slide baseplates for switches may be used with either 109-lb. or 98-lb. rails although at present only 109-lb. switches and crossings are available.

(3) As already mentioned in Part I, the spring clip fastening is used for holding rail to baseplate. The spring clips are made of silico-manganese spring steel, and their shape may be seen in Fig. 10. One end of the clip bears on the foot of the rail and the other end rests in a specially moulded seating which prevents the clip from twisting or moving out of position when the nut of the clip bolt is tightened. A short tee-headed bolt drops into a special hole in the baseplate, and is given a quarter turn which locks it in position. The clip may then be put on, and the nut screwed down on the tee-bolt until tension is put on the rail foot.

(4) Wherever possible the rail seats of baseplates are cambered.

SWITCHES

See British Railway Track—Chapter 3.

Switches of the semi-curved type have been standardised for 109-lb. Flat Bottom material. The switch rail is straight from the toe to the end of the head planing and is then curved

to a radius called the " switch radius ". The range of switches is the same as that originally standardised for Bull Head material with the exception of type A which would be too stiff to operate if made with Flat Bottom rail. General particulars of the five standard switches are given in Table 1 below.

TABLE 1

DETAILS OF SWITCHES

Switch Type	Switch Rail Length	Stock Rail Length	Length of Switch Head Planing	Angle of Switch Planing	Radius of Switch Curve
B	28′-6″	36′-0″	7′-4″	1° 47′ 24″ 1 in 32	614 ft.
C	28′-6″	36′-0″	9′-2″	1° 25′ 56″ 1 in 40	958 ft.
D	28′-6″	36′-0″	11′-0″	1° 11′ 36″ 1 in 48	1,379 ft.
E	32′-8″	36′-0″	14′-8″	0° 53′ 42″ 1 in 64	2,449 ft.
F	37′-8″	41′-0″	18′-4″	0° 42′ 58″ 1 in 80	3,825 ft.

NOTE.—In all cases the toe of switch is 5′-5″ from end of stock rail.

The Flat Bottom switch rails are mounted vertically for the full movable length instead of being inclined inwards, and this enables the wide feet of the rails to move correctly on the horizontal seatings of the slide baseplates. At the end of its movable length each switch rail is twisted to an inclination of 1 in 20, the line of the running edge being carefully maintained. The full twist takes place in a length of about 15″, between consecutive baseplates.

The switch blades are of the undercut type, the metal in one side of the rail head being planed away to fit against and under the stock rail head. The other side of the switch rail head is planed to an inclination of 1 in 5 to the centre line of the rail. The top of the switch rail is also planed for a length equal to the length of side planing (see Table 1), the

switch tip being $\frac{2}{3}\frac{3}{2}$" below the top of the stock rail. The foot of the switch rail is planed away sufficiently to allow it to ride over the foot of the stock rail far enough for the switch to close properly without lifting. The length of the switch foot planing is of course much longer than that of the head planing. Figure 7 shews the toe of a 109-lb. switch rail.

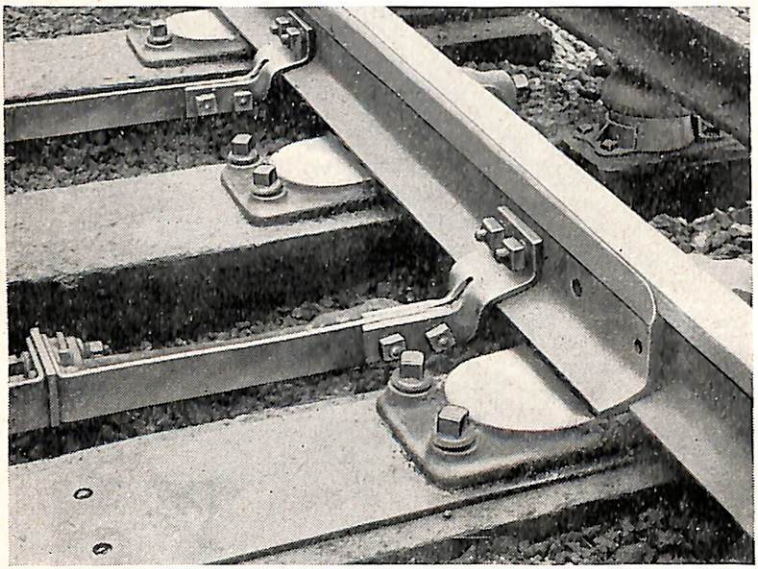


FIG. 7

The stock rails which are not planed, are inclined at 1 in 20 towards the fourfoot. As in the case of Bull Head rails, a set is put in either or both of the stock rails at the switch toe, to provide for Left Hand, Right Hand, or Split turnouts as viewed from a point in front of the switches and looking towards the heel. In the case of Bull Head rails the required set is frequently put in the stock rail on the relaying site but this cannot easily be done with Flat Bottom rails. Pairs of switches are therefore ordered with L.H., R.H., or Split Set as necessary, and the correct bend is made during manufacture.

The fittings for Flat Bottom switches are as follows :—

(1) In front of the switch toe each stock rail rests on two baseplates, these being of the ordinary type used in switches and crossings for carrying the closure rails or wherever it is necessary to support one rail only at

an inclination of 1 in 20. The full designation of the baseplate is 109 & 98 ST, usually referred to simply as the ST baseplate, and it is illustrated in Fig. 10.

(2) A number of slide baseplates carry the movable lengths of the switch rail, and in general design they are similar to the Bull Head slide chairs. The construction is, however, rather different. The very large mass of metal in the rail jaw of the baseplate makes the work of casting it very difficult, and furthermore has the effect of weakening the baseplate as the metal cools. For this reason the rail jaw is made in two parts, a vertical bracket as part of the baseplate casting; and a loose jaw block which keys into it and also provides the necessary support for the stock rail. A stud or stock rail bolt of the usual type holds the rail, jaw block and baseplate bracket rigidly together. The use of loose jaw blocks with horizontally inclined faces makes it possible to match up to the set of any stock rail without varying the positions of the baseplates at the switch toes, and thus one size of soleplate will suit all switches, irrespective of type or direction of set. A general view of a slide baseplate and soleplate end is seen in Fig. 8.

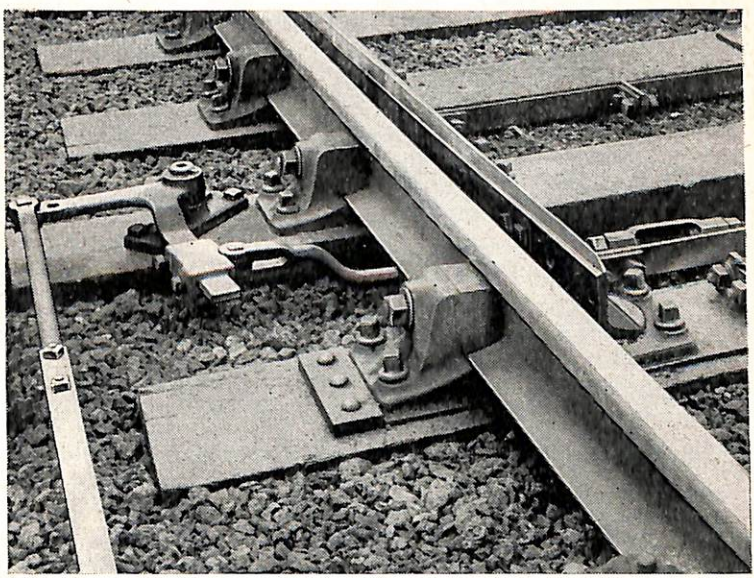


FIG. 8

Slide baseplates are made in three sizes with a progressively increasing length of slide portion, and they are designated 109 P ; 109 P.1 ; 109 P.2 ; the numbers of each for any particular switch being shewn in Table 2. It will be seen that the longest baseplate, the 109 P.2, is only required for B switches.

For the length of the switch head planing, the heads of the switch and stock rails are in contact, but beyond this the rails diverge, and a series of cast iron blocks is provided to maintain the correct distance between them. These blocks, referred to as slide blocks in Table 2, are held by bolts which pass through the stock rail web and through the jaw blocks and brackets of the slide baseplates. The switch rail can move towards the stock rail until its web makes contact with the slide blocks and is supported by them. The blocks vary in size to suit the different switches and are made in Left and Right Hand types. A set of blocks for any one type of switch are numbered, commencing with the block nearest to the switch toe, and the numbers are incorporated in the designations, following letters denoting the switch type and hand, e.g. B.L.1 ; B.R.1 ; C.L.3 ; D.R.5, etc.

(3) At the end of the movable portion of the switch blade, it is necessary to hold the rail firmly in position at a fixed distance from the stock rail and this is done by fitting cast iron distance blocks with bolts passing through both rail webs. With each type of switch two blocks are used before the end of the switch rail is reached, and this makes the assembly very rigid. As the switch rail is held in place by blocks and bolts, it is not necessary to provide switch anchors as used with Bull Head switches. In the case of E and F switches, there are also distance blocks beyond the switch and stock rail ends, two additional for the E and four for the F switches. The twist in switch rail, already referred to, takes place between the first two blocks in each type of switch.

Except in the case of B switches the distance blocks are placed immediately over baseplates and are therefore given the same letters and figures of designation except for the rail weights. The baseplates in this series do not incorporate the rail jaw of the slide baseplates, but have the spring clip and the tee-bolt type of fastening. The baseplates are numbered,

commencing with the one next to the last slide baseplate, and the full designations include rail weight, the letter P, the type of switch and the hand of the baseplate, e.g. 109 & 98 PCL1 ; 109 & 98 PDR3, etc. This series of double baseplates continues beyond the series of distance blocks, until the divergence of the two rails is such as to allow the use of separate baseplates placed side by side. Fig. 9 illustrates the arrangement of blocks and baseplates near the heel of a switch.

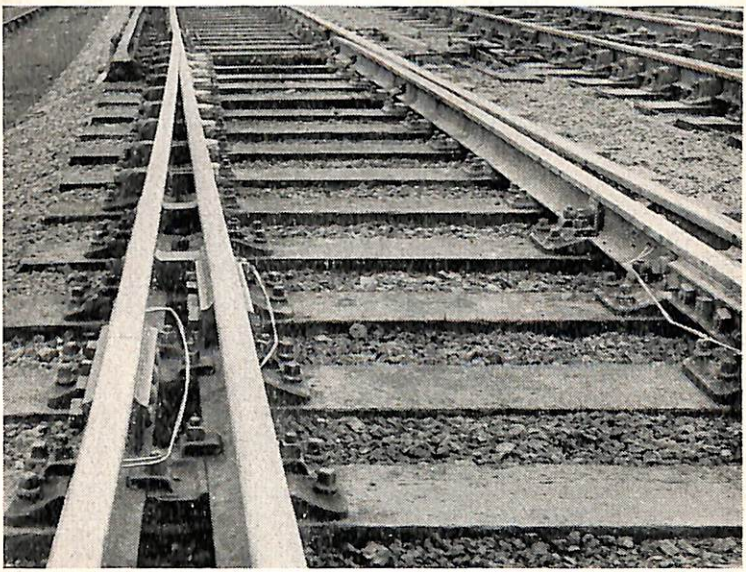
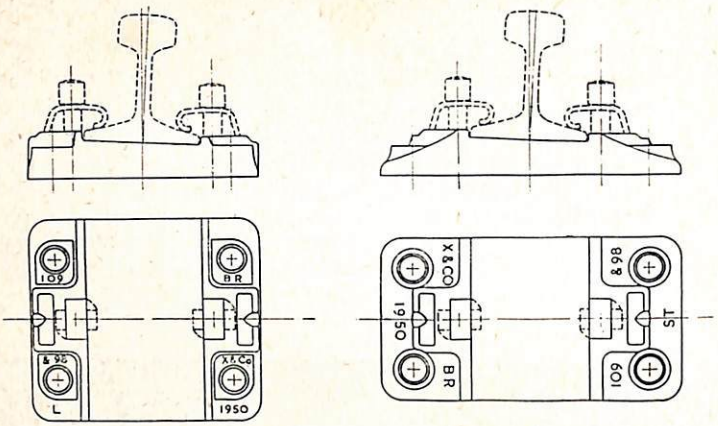


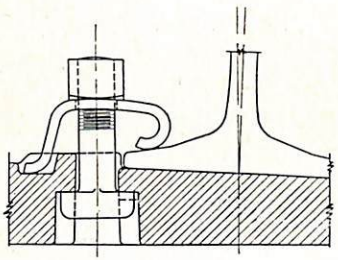
FIG. 9

(4) After the series of double baseplates referred to in the previous paragraph, short baseplates (109 & 98 L) are used and these are followed by ST baseplates. Both types of baseplate are shewn in Fig. 10.

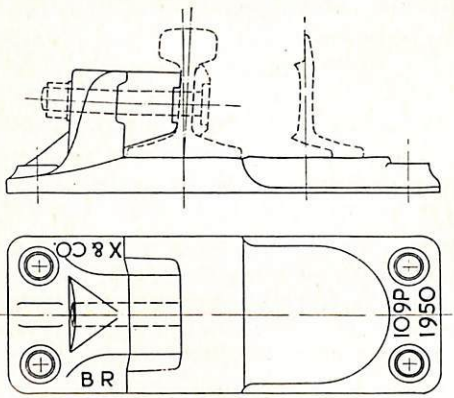
(5) A number of stretcher bars similar to those used with Bull Head switches, connect the two switch blades and hold them in the correct position relative to the stock rails. When a switch is fully open, the opening at the toe is $4\frac{1}{4}''$ and the minimum flangeway gap, at a point near the commencement of the head planing, is $2''$. The first stretcher bar in all cases



L BASEPLATE ST BASEPLATE



CLIP & TEE HEAD BOLT ASSEMBLY



P BASEPLATE

FIG. 10

projects beyond the stretcher bar brackets and passes under each stock rail, $\frac{1}{8}$" below the underside of the rail foot, thus preventing the switch blades from lifting. Movement of the switches is obtained by connecting the driving rod to the first stretcher bar by means of a driving lug fastened to the bar by the two bolts holding one of the stretcher bar brackets to the bar.

(6) One soleplate to maintain the correct gauge at the toe of the switches. As already mentioned this component is a standard one fitting the whole range of switches.

(7) Universal washers are used in conjunction with the distance blocks and through bolts near the switch heel, in place of the usual one-piece cast iron washers. To suit the varying divergence and different inclinations of rails in switches and crossings a very large number of different cast iron washers would have to be manufactured and stocked, and the universal washer has therefore been introduced to take the place of the vast majority of these ordinary washers. It will be seen from Fig. 11 that the assembly consists of a cast iron main washer with a spherical outside face on which is

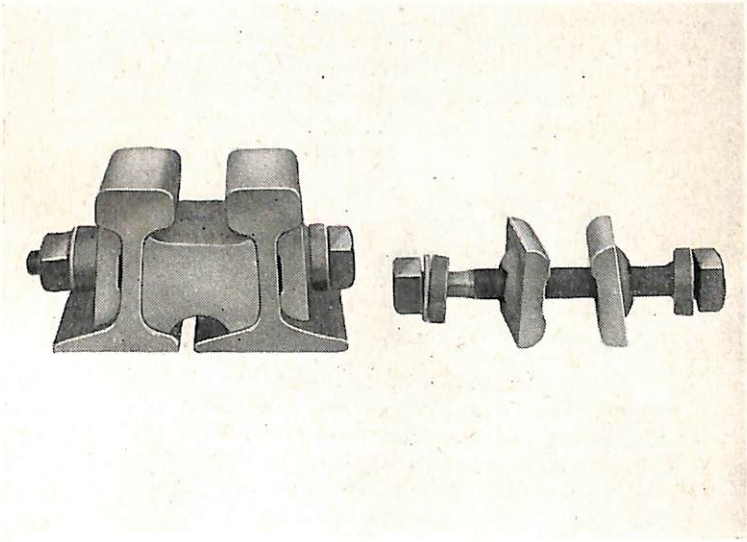


FIG. 11

seated a malleable iron or mild steel auxiliary washer, and the former can therefore take up different positions to suit inclination and horizontal angle of a rail, without affecting the position of the latter. Both washers have square holes to suit the square necks of switch and crossing bolts.

The order of the different types of switch baseplates and the details of the sleeper spacings are given in Table 2 which follows.

COMMON CROSSINGS

See British Railway Track—Chapter 3.

Common crossings in Flat Bottom rail in this country are similar to those in Bull Head rail in general form and layout, and designs for a range of angles from 1 in 4 to 1 in 20 (centre line measurement) have so far been prepared in 109-lb. material. There are, however, certain fundamental changes in the details of the designs, and these are listed below :—

(1) The nose holding-down bolt so familiar in Bull Head crossings no longer appears in the new designs, and long cast iron nose blocks now perform the work of holding the nose firmly in position with a minimum of movement under traffic. The two nose blocks are extended in front of the nose and their inside faces are brought near to, but not actually in contact with each other. A crossing bolt passes through the blocks at a point 3″ in front of the nose and this ensures a good grip on the web of the point rail. See Fig. 12.

(2) A larger number of crossing bolts, and more and larger cast iron blocks are used to hold together the wing rails and crossing vee in order to make the whole assembly more rigid than a Bull Head crossing, thereby spreading the load more effectively, reducing wear of components, and easing maintenance problems.

(3) The customary bending outwards of the wing and check rail ends to give the necessary entry to the flangeway gap, has not been continued. In the Flat Bottom rail designs the rails themselves remain straight at the ends, and the desired flangeway entry is obtained by " flaring " or planing at an angle the rail heads. This treatment can be clearly seen in Figs. 13 and 15, and the advantages of using it are :—

TABLE 2.

109 LB. F.B. SWITCHES - BASEPLATES, SPACINGS & FITTINGS.

B

BASEPLATES	x-ST--ST- P P P P P P P1 P1 P2 P2 1 L--ST-x- (3½" x) ST-x-ST-
SPACINGS	1'-0½" | 2 AT 2'-4" | 2 AT 2'-4½" | 2'-5" | 8 AT 2'-6" | 2 AT 2'-1"
FITTINGS	STOCK RAIL BOLTS | SLIDE BLOCKS | DIST. BLCKS

C

BASEPLATES	x-ST--ST- P P P P P P P P1 P1 1 2 3 x-L--L- (3½" x) L--ST-
SPACINGS	1'-0½" | 2 AT 2'-4" | 2 AT 2'-4½" | 2'-5" | 8 AT 2'-6" | 2 AT 2'-1" | 2'-6"
FITTINGS	STOCK RAIL BOLTS | SLIDE BLOCKS | DISTANCE BLOCKS | DBLE BPLTE

NOTES:

THE FIGURES 1, 2, ETC. DENOTING TYPE OF BASEPLATE ARE ABBREVIATIONS FOR FULL DESCRIPTION OF THE TYPE 109 & 98 PBL1, 109 & 98 PFL3, ETC. IN EACH CASE THE FIFTH AND SIXTH CHARACTERISTICS OF THE FULL DESCRIPTION DENOTE TYPE OF SWITCH AND HAND OF BASEPLATE RESPECTIVELY SIMILARLY ST. IS THE ABBREVIATION FOR 109 & 98 ST, L FOR 109 & 98 L, P FOR 109 P, P1 FOR 109 P1, AND P2 FOR 109 P2 THE MARKS x ON THE BASEPLATE ROWS DENOTE THE POSITIONS OF RAIL JOINTS

D

BASEPLATES	x-ST--ST- P P P P P P P P P P1 1 2 x 3 4 5 L--L- (3½" x) L--ST-
SPACINGS	1'-0½" | 2 AT 2'-4" | 2 AT 2'-4½" | 2'-5" | 8 AT 2'-6" | 2 AT 2'-1" | 3 AT 2'-6"
FITTINGS	STOCK RAIL BOLTS | SLIDE BLOCKS | DISTANCE BLOCKS | DOUBLE BASEPLATES

E

BASEPLATES	x-ST--ST- P P P P P P P P P P P P 1 2 x 3 4 5 6 7 8 L--L--L- (3½" x) L--ST--ST-
SPACINGS	1'-0½" | 2 AT 2'-4" | 4 AT 2'-4½" | 3 AT 2'-5" | 5 AT 2'-6" | 2 AT 2'-1" | 8 AT 2'-6"
FITTINGS	STOCK RAIL BOLTS | SLIDE BLOCKS | DISTANCE BLOCKS | DOUBLE BASEPLATES

F

BASEPLATES	x-ST--ST- P P P P P P P P P P P P P 1 2 x 3 4 5 6 7 8 9 10 11 L--L--L--L--L--L- x L--L--L--ST--ST-
SPACINGS	1'-0½" | 2 AT 2'-4" | 4 AT 2'-4½" | 3 AT 2'-5" | 7 AT 2'-6" | 2 AT 2'-1" | 13 AT 2'-6"
FITTINGS	STOCK RAIL BOLTS | SLIDE BLOCKS | DISTANCE BLOCKS | DOUBLE BASEPLATES

(*a*) Special Right and Left Hand baseplates are not required at the rail ends to allow for the bending outwards of the wings and checks, with consequent reduction in stocks for replacement purposes.

(*b*) The angle of entry can if necessary be varied to suit high speeds by lengthening the rail and flare, and without the use of special baseplates.

FIG. 12

The common crossing vee is made in the usual way, by housing the splice rail into the point rail, bolting the two rails together with driving fit splice bolts and then planing the heads and feet as necessary. The width of the blunt nose of the vee has however been standardised at $\frac{5}{8}$″ instead of the former $\frac{3}{4}$″, with the result that the nose is now slightly nearer to the point of intersection of the gauge lines, e.g. for a 1 in 8 crossing the distance is now 5″ instead of 6″ with the $\frac{3}{4}$″ nose. The housing of the splice rail head into the point rail head follows the usual Bull Head pattern, but in addition a foot housing has been incorporated. By this means the splice rail is prevented from "creeping" forward out of the head housing which would restrict the flangeway gap.

The top planing of the vee also follows Bull Head practice, the depth of planing at the nose being $\frac{3}{16}''$. The profile of the nose after the top planing and the side planing have been completed is shewn in Fig. 14. Each side of the head of the vee is then rounded to a radius of $\frac{1}{2}''$, and when these radii are carried forward to the nose they intersect each other, and this has the effect of lowering still further the height of the nose. Finally the nose profile is milled down slightly to ensure that the nose tip cannot be struck by wheel flanges.

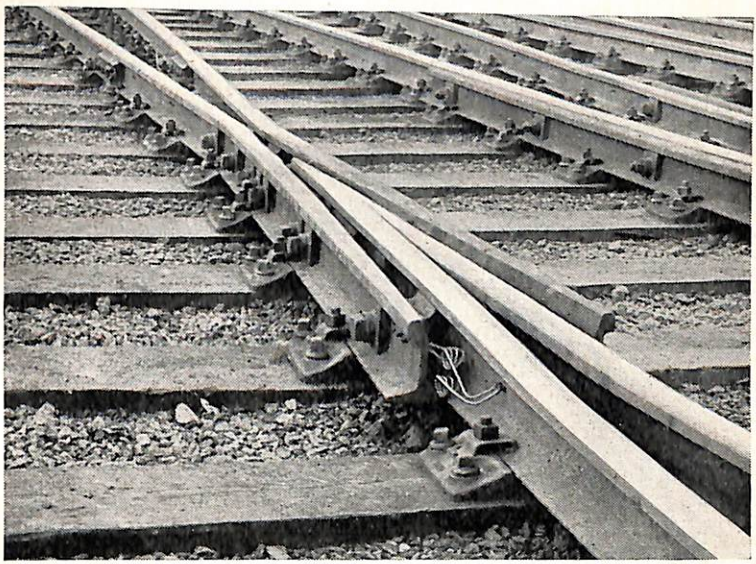
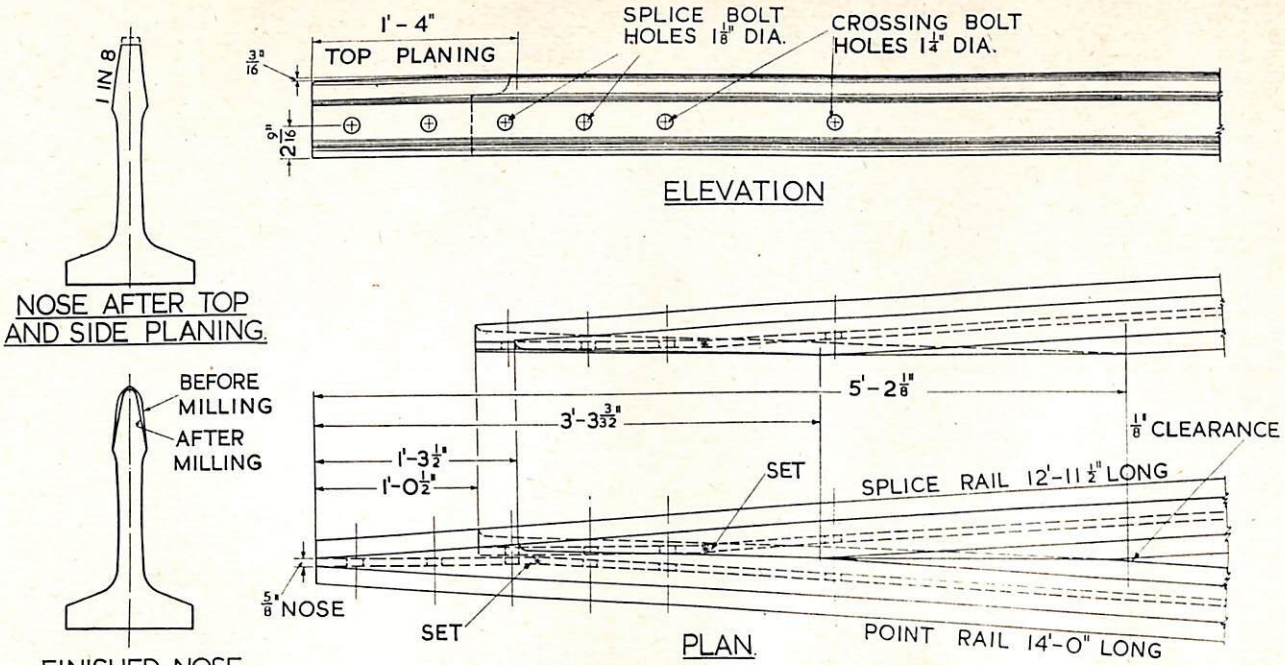


FIG. 13

A typical common crossing vee is illustrated in Fig. 14 and it will be seen that reference is made to a clearance of $\frac{1}{8}''$ between the feet of the point and splice rails at the place where they would be expected to come into contact. This clearance is provided so that a certain amount of curvature can, if necessary, be given to the point or splice rail commencing at the heel of splice.

When a common crossing is laid in the track it is preferable to arrange for the point rail to be in the line carrying most of the traffic, and it is therefore necessary to provide right and left handed crossings. The handing of a crossing is decided by the position of the splice rail when viewed from a point



DETAILS OF 1 IN 8 COMMON CROSSING "VEE"

FIG. 14.

in front of the nose, so that a crossing having the splice on the left of the point rail would be described as a " Left Hand Splice Crossing ".

Common crossing baseplates are given letters to denote their position, as was done in the case of Bull Head chairs, e.g. X ; Y ; A ; B ; C, etc. and the full designations carry weight of rail and angle of crossing for which they are intended. Typical designations are :—109 & 98 — 8A ; 109 & 98 — 12X, etc. The A baseplate carries the crossing nose, its centre line and that of the timber on to which it is screwed being 5″ behind the actual nose. The other baseplates are then spaced at 2′ 6″ centres in either direction from the A baseplate, except in two cases on the 1 in 20 crossing where there is a dimension of 2′ 2″ between the H and J, and also between the Z2 and Z3 baseplates, due to the presence of rail joints. Table 3 gives details of the special common crossing baseplates and also shews the relative positions of the rail joints.

The wing rails are canted towards each other at the usual inclination of 1 in 20, and the point and splice rails are vertical from the nose of crossing to the heel of foot planing, beyond which they are twisted to the full inclination of 1 in 20, towards the wing rails. The twist takes place between two consecutive baseplates and the position for each crossing is also shewn in Table 3.

The lengths of the rails and a few of the main dimensions for the common crossings in the present range are set out in Table 4.

Parallel wing crossings are available in Flat Bottom material, and in those cases standard length wing rails without the flared head are used with wing rail extensions fishplated to them. The extension rails are cut to the required length and the heads flared in the usual way. The appropriate P.W. baseplates are, of course, supplied with the crossings and cast iron blocks are placed between the wing extensions and the point or splice rails at intervals of approx. 5 ft. Parallel wing crossings are described in the usual way i.e. 1 in 8 L.H.P.W.

Common crossing check rails are inclined at 1 in 20 towards the adjacent running rails and thus the baseplates which carry them (109 & 98 C) can also be used for parallel wing extensions beyond the special crossing baseplates. A somewhat shortened version of the standard check baseplate, called the 109 & 98 LC, is also available for complicated switch and crossing work where the amount of space on the

crossing timbers is limited. It will be seen from Table 4 that three standard lengths of check rail are used with common crossings, namely 13′-0″; 15′-6″; and 18′-0″, and in all cases they are secured to the running rail by means of cast iron blocks and through bolts. In Fig. 15 can be seen a standard 15′-6″ check with flared head, through bolts and universal washer.

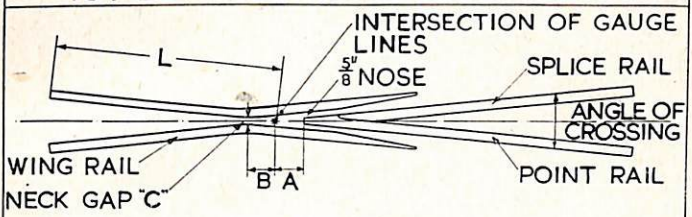
TABLE 3

BASEPLATES FOR COMMON CROSSINGS

Angle of Crossing	Joint			Twist					Joint						
1 in 4				X	A	B									
1 in 4¼				X	A	B									
1 in 4½				X	A	B	C								
1 in 4¾				X	A	B	C								
1 in 5				X	A	B	C								
1 in 5¼				X	A	B	C								
1 in 5½				X	A	B	C								
1 in 5¾			Y	X	A	B	C								
1 in 6			Y	X	A	B	C	D							
1 in 6½			Y	X	A	B	C	D							
1 in 7			Y	X	A	B	C	D							
1 in 7½			Y	X	A	B	C	D							
1 in 8			Y	X	A	B	C	D							
1 in 8½			Y	X	A	B	C	D	E						
1 in 9			Y	X	A	B	C	D	E						
1 in 9½		Z	Y	X	A	B	C	D	E						
1 in 10		Z	Y	X	A	B	C	D	E						
1 in 10½		Z	Y	X	A	B	C	D	E						
1 in 11		Z	Y	X	A	B	C	D	E	F					
1 in 12		Z	Y	X	A	B	C	D	E	F					
1 in 13	Z1	Z	Y	X	A	B	C	D	E	F	G				
1 in 14	Z1	Z	Y	X	A	B	C	D	E	F	G				
1 in 16	Z2	Z1	Z	Y	X	A	B	C	D	E	F	G	H		
1 in 18	Z2	Z1	Z	Y	X	A	B	C	D	E	F	G	H	J	
1 in 20	Z3	Z2	Z1	Z	Y	X	A	B	C	D	E	F	G	H	J K

TABLE 4

109 LB COMMON CROSSINGS.



CROSSING	ANGLE	A	B	C	L	LENGTH OF POINT RAIL	LENGTH OF SPLICE RAIL	LENGTH OF WING RAILS	LENGTH OF CHECK RAILS
1 IN 4	14°-15'-00"	2 1/2"	7 1/16"	2 9/64"	7'-11 1/2"	11'-6"	11'-0"	12'-6"	13'-0"
1 IN 4 1/4	13°-25'-11"	2 21/32"	7 31/64"	2 3/32"	7'-11 11/32"	11'-6"	11'-0"	12'-6"	13'-0"
1 IN 4 1/2	12°-40'-49"	2 13/16"	7 59/64"	2 1/16"	7'-11 3/16"	11'-6"	11'-0"	12'-6"	13'-0"
1 IN 4 3/4	12°-01'-05"	2 31/32"	8 23/64"	2 1/32"	7'-11 1/32"	11'-6"	10'-11 1/2"	12'-6"	13'-0"
1 IN 5	11°-25'-16"	3 1/8"	8 51/64"	2"	7'-10 7/8"	11'-6"	10'-11 1/2"	12'-6"	13'-0"
1 IN 5 1/4	10°-52'-50"	3 9/32"	9 15/64"	2"	7'-10 23/32"	11'-6"	10'-11 1/2"	12'-6"	13'-0"
1 IN 5 1/2	10°-23'-20"	3 7/16"	9 43/64"	2"	7'-10 9/16"	11'-6"	10'-11 1/2"	12'-6"	13'-0"
1 IN 5 3/4	09°-56'-22"	3 19/32"	10 3/32"	2"	7'-10 13/32"	11'-6"	10'-11 1/2"	12'-6"	13'-0"
1 IN 6	09°-31'-38"	3 3/4"	10 17/32"	2"	7'-10 1/4"	11'-6"	10'-11 1/2"	12'-6"	13'-0"
1 IN 6 1/4	08°-47'-51"	4 1/16"	11 3/32"	2"	7'-9 15/16"	11'-6"	10'-10 1/2"	12'-6"	13'-0"
1 IN 7	08°-10'-16"	4 3/8"	1'-0 9/32"	2"	7'-9 5/8"	14'-0"	13'-3"	12'-6"	13'-0"
1 IN 7 1/2	07°-37'-41"	4 11/16"	1'-1 5/32"	2"	7'-9 3/16"	14'-0"	13'-3"	12'-6"	13'-0"
1 IN 8	07°-09'-10"	5"	1'-2 1/32"	2"	7'-9"	14'-0"	12'-11 1/2"	12'-6"	13'-0"
1 IN 8 1/2	06°-43'-59"	5 5/16"	1'-2 29/32"	2"	7'-8 11/16"	14'-0"	12'-11 1/2"	12'-6"	13'-0"
1 IN 9	06°-21'-35"	5 5/8"	1'-3 25/32"	2"	7'-8 3/8"	14'-0"	12'-11 1/2"	12'-6"	13'-0"
1 IN 9 1/2	06°-01'-32"	5 15/16"	1'-4 21/32"	2"	7'-8 1/16"	14'-0"	12'-11 1/2"	12'-6"	13'-0"
1 IN 10	05°-43'-29"	6 1/4"	1'-5 33/64"	2"	7'-7 3/4"	14'-0"	12'-11 1/2"	12'-6"	13'-0"
1 IN 10 1/2	05°-27'-10"	6 9/16"	1'-6 25/64"	2"	10'-1 7/16"	16'-6"	15'-3"	17'-6"	15'-6"
1 IN 11	05°-12'-18"	6 7/8"	1'-7 17/64"	2"	10'-1 1/8"	16'-6"	15'-3"	17'-6"	15'-6"
1 IN 12	04°-46'-19"	7 1/2"	1'-9 1/64"	2"	10'-0 1/2"	16'-6"	15'-0 1/2"	17'-6"	15'-6"
1 IN 13	04°-24'-19"	8 1/8"	1'-10 49/64"	2"	9'-11 7/8"	16'-6"	14'-9"	17'-6"	18'-0"
1 IN 14	04°-05'-27"	8 3/4"	2'-0 23/64"	2"	9'-11 1/4"	16'-6"	14'-9"	17'-6"	18'-0"
1 IN 16	03°-34'-47"	10"	2'-4 7/32"	2"	12'-4"	19'-0"	16'-10"	20'-0"	18'-0"
1 IN 18	03°-10'-56"	11 1/4"	2'-7 33/64"	2"	12'-2 3/4"	19'-0"	16'-8 1/4"	20'-0"	18'-0"
1 IN 20	02°-51'-51"	1'-0 1/2"	2'-11 11/64"	2"	12'-1 1/2"	19'-0"	16'-8 1/4"	20'-0"	18'-0"

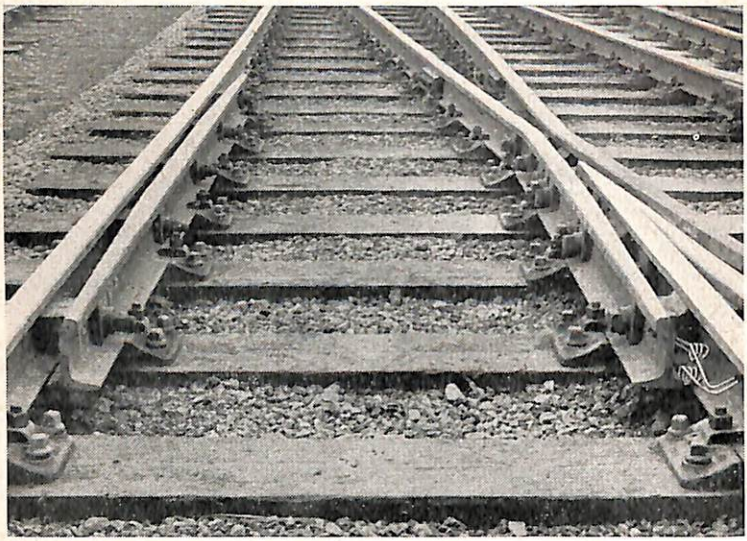


FIG. 15

STANDARD LEADS

The standard switches and common crossings may be combined to give turnouts of varying leads and radii, and the dimensions of those in general use are given in Table 5. On examining the particulars given in the table it will be seen that each switch has a " natural " angle of crossing to go with it, where the radius of switch curve is equal to the radius of turnout curve. These combinations are :—B-8 ; C-10 ; D-12 ; E-16 and F-20. If any particular switch is combined with a wider angle of crossing than the " natural " one, the turnout radius is sharper than the switch radius, but where the switch is used with a flatter angle, the turnout radius is the same as the switch radius, and there is a length of straight rail just in front of the crossing.

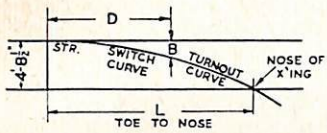
OBTUSE CROSSINGS

See British Railway Track—Chapter 3.

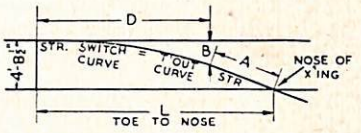
As in the case of common crossings, the obtuse crossings in Flat Bottom rail follow the same general layout as those in Bull Head rail but incorporate certain fundamental changes in the design of components. Designs have so far been prepared for a range of obtuse crossings with angles from 1 in 4 to 1 in 8.

TABLE 5

109 LB TURNOUTS



TYPE 1



TYPE 2

SWITCH	CROSSING	L	SWITCH CURVE RADIUS	TURNOUT CURVE RADIUS	D	B	A	TYPE OF TURNOUT
B	1 IN 6	58'-1 1/8"	614 FT.	301 FT.	27'-0"	1'-1 3/8"	NIL	1
	1 IN 6½	59'-11 1/4"	614 FT.	363 FT	27'-0"	1'-1 3/8"	NIL	1
	1 IN 7	61'-8 1/2"	614 FT.	435 FT.	27'-0"	1'-1 7/8"	NIL	1
	1 IN 7½	63'-4 5/8"	614 FT.	518 FT.	27'-0"	1'-1 7/8"	NIL	1
	1 IN 8	65'-0 3/8"	614 FT.	614 FT.	27'-0"	1'-1 7/8"	NIL	1
	1 IN 8½	65'-2 3/8"	614 FT.	614 FT.	60'-1 3/4"	4'-2"	5'-1"	2
	1 IN 9	65'-7 5/8"	614 FT.	614 FT.	56'-2"	3'-8 1/2"	9'-6"	2
	1 IN 9½	66'-2 7/8"	614 FT.	614 FT.	52'-7 3/8"	3'-3 3/8"	13'-8 3/8"	2
	1 IN 10	67'-0 1/2"	614 FT.	614 FT.	49'-4 3/8"	2'-11 1/8"	17'-8 3/4"	2
C	1 IN 7	69'-7 1/4"	958 FT.	412 FT.	29'-11 1/2"	11 3/4"	NIL	1
	1 IN 7½	71'-9"	958 FT.	481 FT.	29'-11 1/2"	11 3/4"	NIL	1
	1 IN 8	73'-9 1/2"	958 FT.	558 FT	29'-11 1/2"	11 3/4"	NIL	1
	1 IN 8½	75'-9 1/8"	958 FT.	643 FT	29'-11 1/2"	11 3/4"	NIL	1
	1 IN 9	77'-8 1/8"	958 FT.	737 FT.	29'-11 1/2"	11 3/4"	NIL	1
	1 IN 9½	79'-6 1/4"	958 FT.	842 FT.	29'-11 1/2"	11 3/4"	NIL	1
	1 IN 10	81'-3 3/4"	958 FT.	958 FT.	29'-11 1/2"	11 3/4"	NIL	1
	1 IN 10½	81'-5 3/8"	958 FT.	958 FT.	76'-3 1/8"	4'-3 1/8"	5'-2 1/3"	2
	1 IN 11	81'-9 1/2"	958 FT.	958 FT.	72'-1 5/8"	3'-10 5/8"	9'-8 3/8"	2
	1 IN 12	83'-0 1/8"	958 FT.	958 FT.	64'-11"	3'-3"	18'-1 3/4"	2
D	1 IN 8	81'-4 3/4"	1379 FT.	536 FT.	34'-6 1/2"	11"	NIL	1
	1 IN 8½	83'-7 1/4"	1379 FT.	613 FT.	34'-6 1/2"	11"	NIL	1
	1 IN 9	85'-9 3/8"	1379 FT.	697 FT.	34'-6 1/2"	11"	NIL	1
	1 IN 9½	87'-10 5/8"	1379 FT.	788 FT.	34'-6 1/2"	11"	NIL	1
	1 IN 10	89'-11 7/8"	1379 FT.	887 FT.	34'-6 1/2"	11"	NIL	1
	1 IN 10½	91'-11 1/8"	1379 FT.	995 FT.	34'-6 1/2"	11"	NIL	1
	1 IN 11	93'-10 3/8"	1379 FT.	1112 FT.	34'-6 1/2"	11"	NIL	1
	1 IN 12	97'-7"	1379 FT.	1379 FT.	34'-6 1/2"	11"	NIL	1
	1 IN 13	98'-0 1/8"	1379 FT.	1379 FT.	88'-2"	4'-0"	9'-10 3/8"	2
	1 IN 14	99'-0 5/8"	1379 FT.	1379 FT.	80'-7 1/2"	3'-5 1/4"	18'-5 3/4"	2
	1 IN 16	102'-6 7/8"	1379 FT.	1379 FT.	68'-4 1/2"	2'-7 1/2"	34'-3 3/8"	2
E	1 IN 10	105'-8 5/8"	2449 FT.	824 FT.	46'-7 1/2"	11 1/4"	NIL	1
	1 IN 10½	107'-11 7/8"	2449 FT.	917 FT.	46'-7 1/2"	11 1/4"	NIL	1
	1 IN 11	110'-2 3/4"	2449 FT.	1016 FT.	46'-7 1/2"	11 1/4"	NIL	1
	1 IN 12	114'-6 1/2"	2449 FT.	1234 FT.	46'-7 1/2"	11 1/4"	NIL	1
	1 IN 13	118'-8 1/4"	2449 FT.	1483 FT.	46'-7 1/2"	11 1/4"	NIL	1
	1 IN 14	122'-7 1/8"	2449 FT.	1765 FT.	46'-7 1/2"	11 1/4"	NIL	1
	1 IN 16	130'-1 5/8"	2449 FT.	2449 FT.	46'-7 1/2"	11 1/4"	NIL	1
	1 IN 18	132'-4"	2449 FT.	2449 FT.	112'-4 1/8"	3'-7 3/4"	20'-0 1/4"	2
F	1 IN 12	130'-2"	3825 FT.	1173 FT.	59'-1 1/2"	11 1/2"	NIL	1
	1 IN 13	134'-8 7/8"	3825 FT	1397 FT.	59'-1 1/2"	11 1/2"	NIL	1
	1 IN 14	139'-1 3/4"	3825 FT.	1646 FT.	59'-1 1/2"	11 1/2"	NIL	1
	1 IN 16	147'-6 1/4"	3825 FT.	2229 FT.	59'-1 1/2"	11 1/2"	NIL	1
	1 IN 18	155'-4 1/4"	3825 FT.	2946 FT.	59'-1 1/2"	11 1/2"	NIL	1
	1 IN 20	162'-8 1/4"	3825 FT.	3825 FT.	59'-1 1/2"	11 1/2"	NIL	1

RADII TO NEAREST FT : OTHER DIMENSIONS TO NEAREST 1/8"

The special long cast iron nose blocks already described are also used in obtuse crossings, and can be clearly seen in Fig. 16. The width of the noses of the point rails are $\frac{1}{2}$" as compared with the $\frac{5}{8}$" noses of the common crossings, this having been done to reduce as much as possible the long gap which exists between the two point rails of an obtuse crossing.

The check rails are inclined towards the wing rails at 1 in 20, and the standard flared head is used as an entry to the flange-way gap. The neck gap for obtuse crossings 1 in 5 to 1 in 8 inclusive is 2", but for crossings 1 in 4 to 1 in $4\frac{3}{4}$ the gap is slightly greater as it is not possible with such wide angles to obtain a sharp enough bend in the check and wing rails to achieve that dimension. For the whole range of obtuse crossings the length of check rail is standardised at 13'-0". The wing rails are 14'-0" long for crossings 1 in 4 to 1 in 6 inclusive, and 18'-4" for crossings 1 in $6\frac{1}{2}$ to 1 in 8.

The baseplate nomenclatures are similar to those for Bull Head chairs, incorporating the letter D for diamond, the angle of crossing and type and hand of baseplate. Typical full designations are :—109 & 98 D5AL, 109 & 98 D5BR etc. The order of baseplates for the full range of obtuse crossings is given in Table 6, and it will be seen that two types not previously mentioned are now included. The first, the LDC baseplate, is very similar to the short check baseplate, LC, in appearance, but has one vital difference, it supports the obtuse point rail where it is vertical. Thus the LC carries two rails inclined at 1 in 20 towards each other and the LDC carries one rail vertical and the other inclined at 1 in 20 towards it. The second of the new types of baseplate is the STO, a half-baseplate which has a jaw block and bracket like those of the P baseplate. The letter O stands for " outside ", denoting the position of the baseplate relative to the inclined rail which it supports. A corresponding baseplate called the STN is available for use on the inside, or fourfoot side of the rail.

SINGLE AND DOUBLE SLIPS

See British Railway Track—Chapter 3.

Designs have now been prepared for diamond crossings with single and double slip roads, angles 1 in 7, $7\frac{1}{2}$, and 8, and in general layout they closely resemble their Bull Head counterparts. The special features of the Flat Bottom common and obtuse crossings and switches are, of course, incorporated, and in Table 7 are given the more important dimensions.

TABLE 6

OBTUSE CROSSING BASEPLATES

Angle of Crossing	Baseplates						
1 in 4	LDC ST	LDC STO	AL	—	AR	LDC STO	LDC ST
1 in 4¼	LDC ST	LDC STO	AL	—	AR	LDC STO	LDC ST
1 in 4½	LDC ST	LDC STO	AL	—	AR	LDC STO	LDC ST
1 in 4¾	LDC ST	BL	AL	—	AR	BR	LDC ST
1 in 5	LDC L	BL	AL	N	AR	BR	LDC L
1 in 5¼	LDC L	BL	AL	N	AR	BR	LDC L
1 in 5½	LDC L	BL	AL	N	AR	BR	LDC L
1 in 5¾	LDC L	BL	AL	N	AR	BR	LDC L
1 in 6	LDC L	BL	AL	N	AR	BR	LDC L
1 in 6½	LDC STO	BL	AL	N	AR	BR	LDC STO
1 in 7	LDC STO	BL	AL	N	AR	BR	LDC STO
1 in 7½	CL	BL	AL	N	AR	BR	CR
1 in 8	CL	BL	AL	N	AR	BR	CR

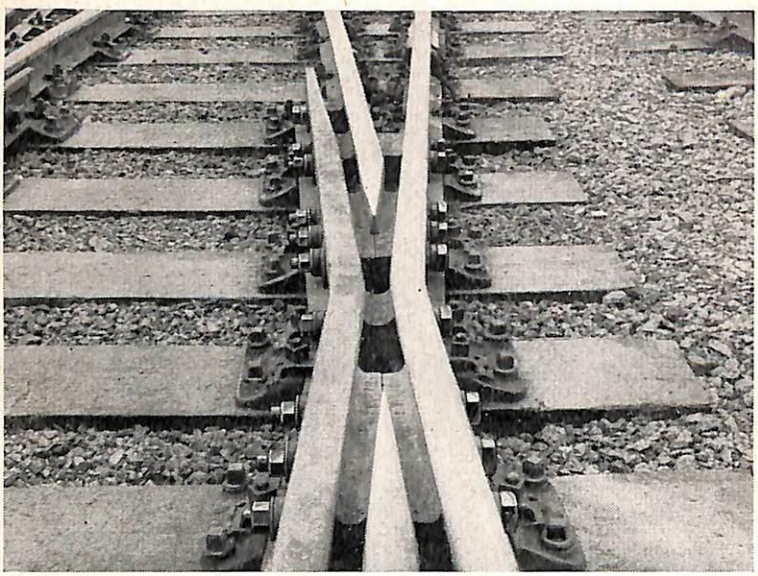


FIG. 16

DESIGNS IN COURSE OF PREPARATION

(1) Common and obtuse crossings for angles 1 in $1\frac{1}{2}$ to 1 in 4.

Certain departures from the general principles of design previously described, will be necessitated by the difficulties which arise in bending the very stiff Flat Bottom rails to the limits required for these angles.

(2) Switch diamond crossings.

Designs are now being prepared for a range of switch diamonds and the general layouts will be similar to those in Bull Head material.

(3) Two-level switches.

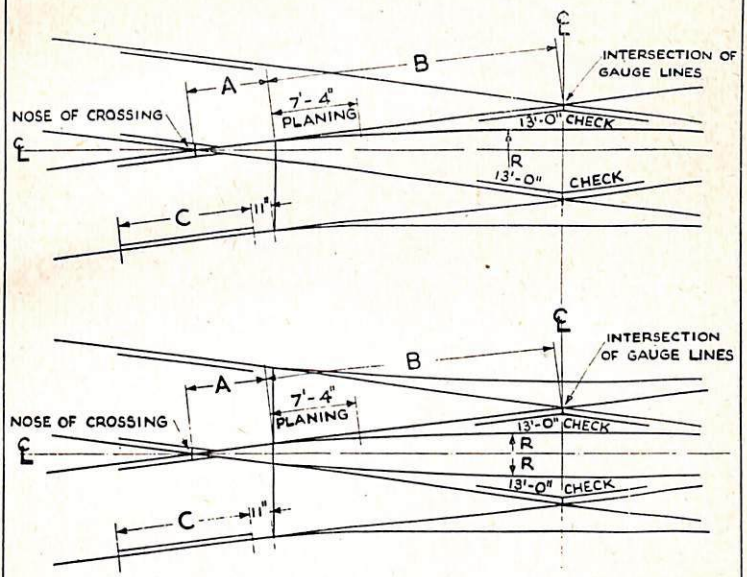
This method of obtaining superelevation in a turnout referred to in British Railway Track—Chapter 3, may also be used in Flat Bottom leads, and designs are now almost complete for a range of two-level switches.

(4) Single and double tongue catchpoints.

Half or complete sets of standard B switches may be used for catchpoints, but as an alternative modified designs have been prepared. Standard length switch blades and shortened stock rails are used in the new designs.

TABLE 7

109 LB. DIAMONDS WITH SINGLE AND DOUBLE SLIPS.



NUMBER OF SLIP	A † TOE TO NOSE	B † INT'SN GAUGE LINES TO TOE	C LENGTH OF CHECK RAILS	R RADIUS OF SLIP TO NEAREST FOOT	R RADIUS OF SLIP IN CHAINS
1 IN 7	6'- 8 5/8"	26'-9 1/4"	10'-6"	484	7·33
1 IN 7 1/2	6'- 9 7/8"	29'-0 3/8"	10'-6"	613	9·29
1 IN 8	8'- 11 3/4"	29'- 3"	13'-0"	702	10·63

† DIMENSIONS TO NEAREST 1/8"

MAINTENANCE

Maintenance procedure in the case of Flat Bottom switches and crossings is practically the same as that for Bull Head material (See British Railway Track) but there are one or two points which must be emphasised :—

(1) There is very little space between the feet of the wing and point or splice rails, and between the switch and stock rails, and this may allow an accumulation of ballast stone or snow. A careful watch must be kept for this condition, and foreign matter removed when necessary.

(2) Care must be exercised in tightening up the nuts of the tee-headed clip bolts. Nuts should be tightened with a box spanner, and on no account should more than one man operate the spanner at any time, otherwise the spring clip will almost certainly be deformed and over-stressed and may break.

(3) Replacement wing rails for Flat Bottom crossings cannot be made at the lineside, because it is necessary to plane a considerable amount of metal off on one side of the foot and also off the head for the flared flangeway entry. Furthermore bending the rail to obtain the correct neck gap is a difficult operation because the wide rail foot may be easily distorted.

ACKNOWLEDGMENTS

The Institution is indebted to Mr. J. C. L. Train, M.C., M.I.C.E. of the Railway Executive, for permission to publish details of British Standard Flat Bottom Track.

The Author also wishes to express his thanks to Messrs. Taylor Bros. (Sandiacre) Ltd. for the photograph of the Universal Washer ; to Mr. C. C. B. Herbert for the preparation of the remainder of the photographs, and to colleagues on the London Midland Region of British Railways for assistance in preparation of diagrams.

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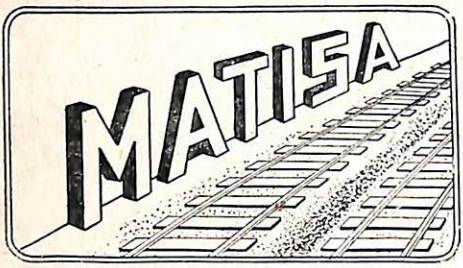

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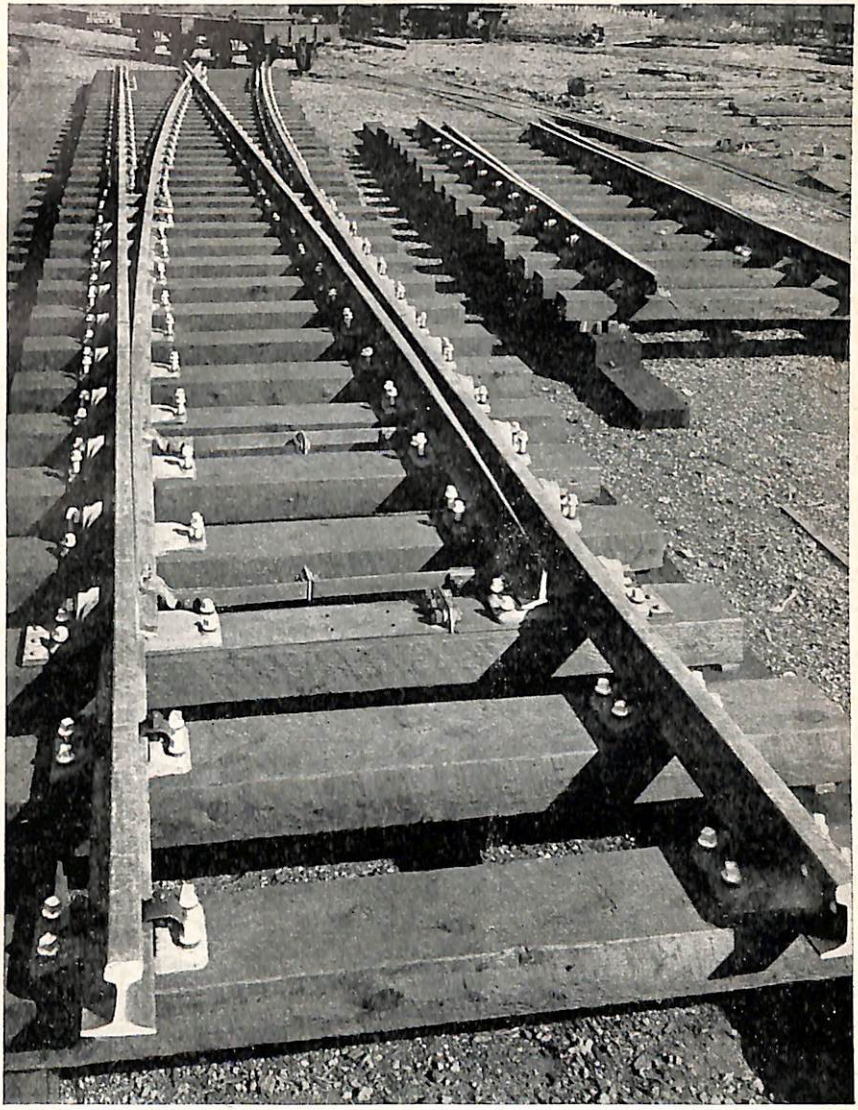

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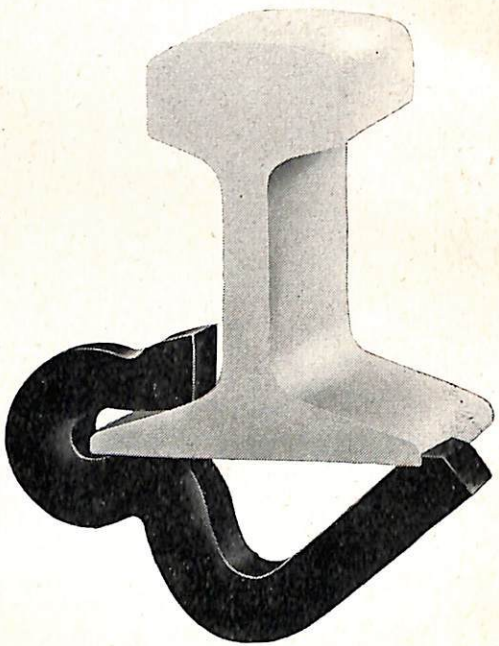

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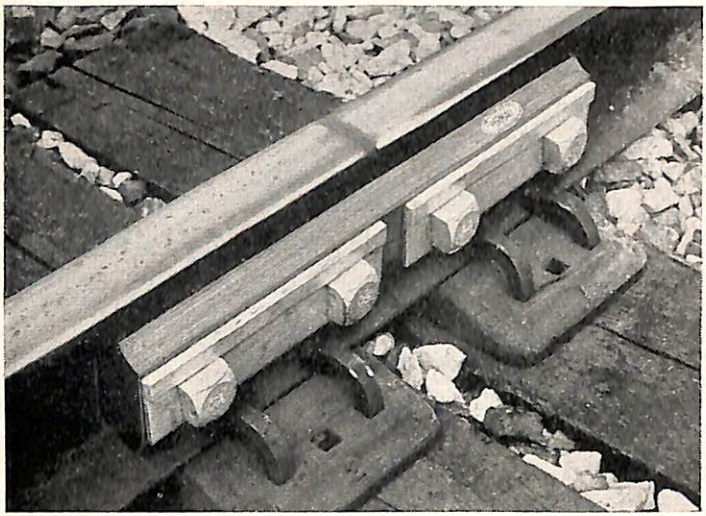

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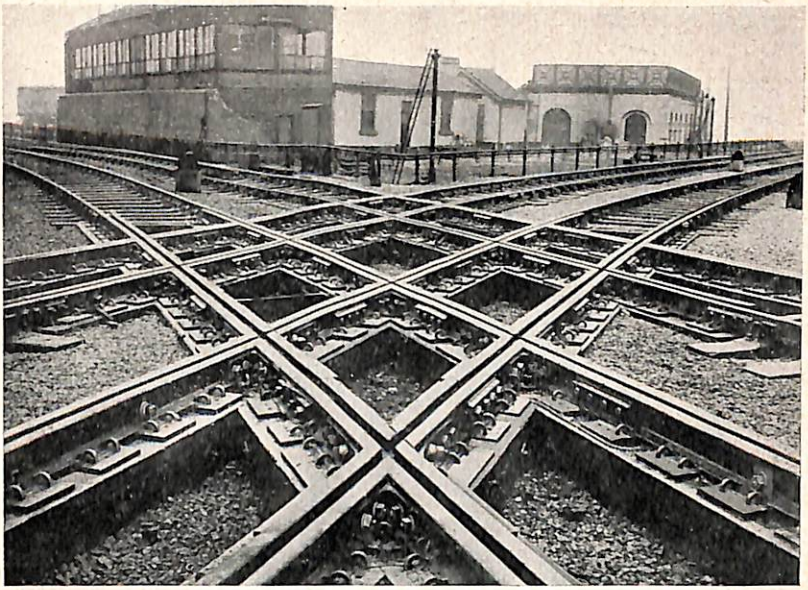

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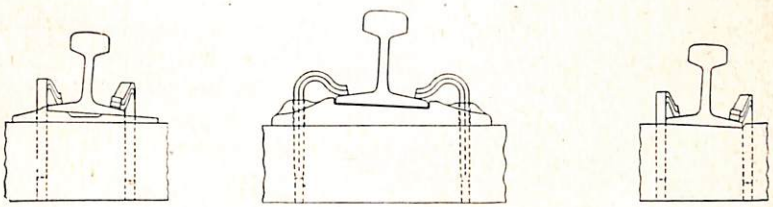

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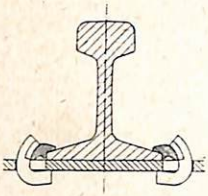
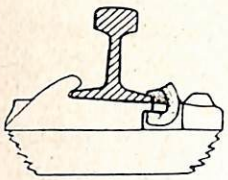
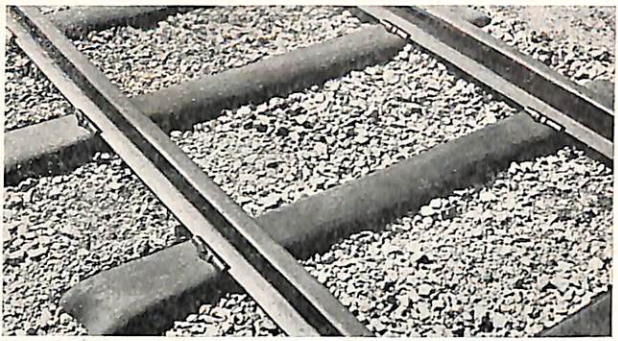
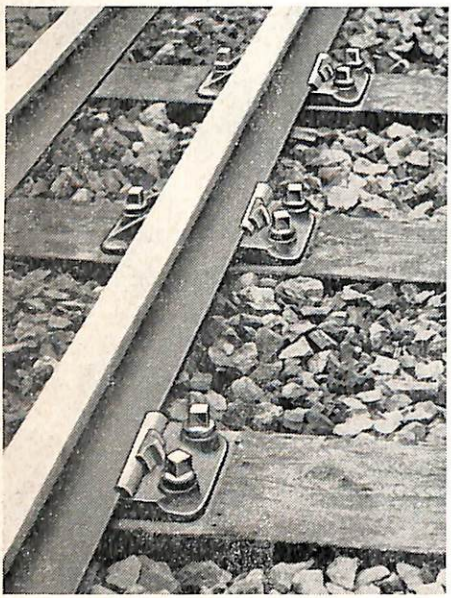






WITH STEEL SLEEPERS



WITH CAST-IRON BASEPLATES

Photo by courtesy of British Railways.

Mills jaws are removable, fitting into four round holes along centre line of a steel sleeper, or in the case of a wood sleeper into specially cast baseplates. Made of special steel and heat treated, they exert a positive resilient grip when taper keys are driven.

The strongest known rail fastening — tests show rails would bend before keys or jaws became loose.

Can be set at any angle to the sleeper, suit any degree of taper in the key. Ideal for the lead rails of turnouts ; greatly facilitate relaying.

Standard in India and Pakistan ; applicable wherever metal sleepers or cast-iron baseplates are used.

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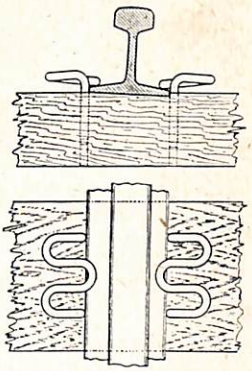
MACBETH SPIKE ANCHORS

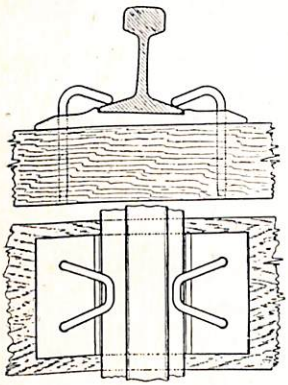
IN USE ON THE GOLD COAST RAILWAY

TYPE No. 2



In No. 2 Type, the legs locate the rail to gauge. Recommended where no baseplates or small-area baseplates are required — e.g. with hardwood sleepers, or with softwood sleepers where traffic is light.

TYPE No. 3



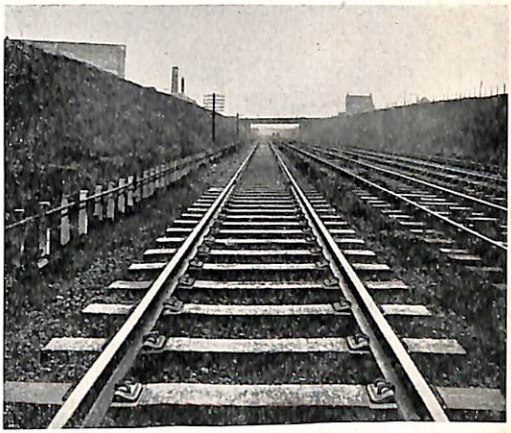


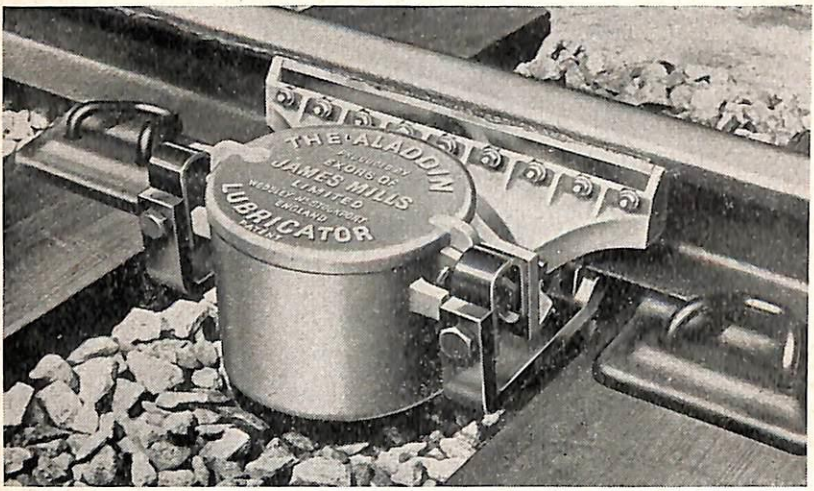
Photo by courtesy of British Railways

For use with large-area cast-iron or steel baseplates, suitable for the heaviest and fastest traffic. Can be used with timber or concrete sleepers.

- POSITIVE GRIP.
  PERMANENT TWO-WAY ANCHORAGE.
  DOUBLE ROUND LEGS FITTING IN ROUND HOLES.
  EASY FITTING AND EXTRACTION.
  SIMPLE DESIGN : LOW COST.

WOODLEY, NEAR STOCKPORT

ALADDIN RAIL AND WHEEL FLANGE LUBRICATOR



The simplest grease lubricator. Operated solely by vibration in the rail set up by passing traffic ; no part is touched by the wheels.

- VIRTUALLY NO MECHANICAL WORKING PARTS — NO WEAR AND TEAR.
- OUTPUT OF GREASE ADJUSTABLE TO SUIT ANY LOCATION.
- NO ALTERATIONS REQUIRED TO THE TRACK, DRILLING OF RAILS ETC.
- STANDARD MODEL FITS ANY STANDARD RAIL OF 60 LBS./YD. AND HEAVIER, BULLHEAD OR FLATBOTTOM.
- PERFORMANCE PROVED ON ALL TYPES OF RUNNING LINES.

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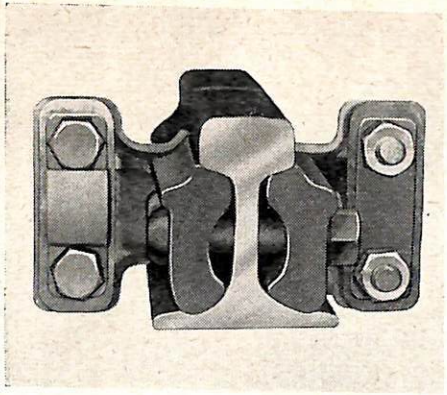

109 F.B. Rail
INSULATED JOINT
Provides steel support to the rail ends.

Drop forged
JUNCTION FISHPLATES
109/95 109/109 109/98
All with wear from 0 – 3/8″

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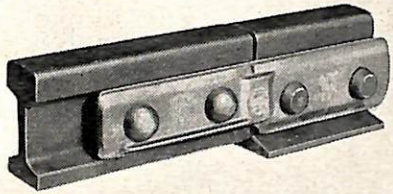
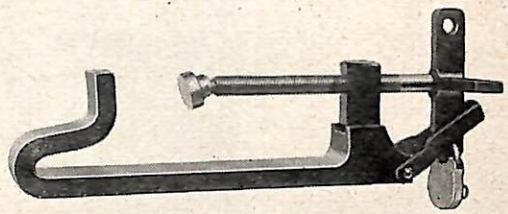
SWITCH CLAMP
The NATIONAL fits ALL B.R. F.B. Rails (109, 98, 110, 113)





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109 F.B. SWITCH SOLEPLATES
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THE REMEDY FOR LOW JOINTS

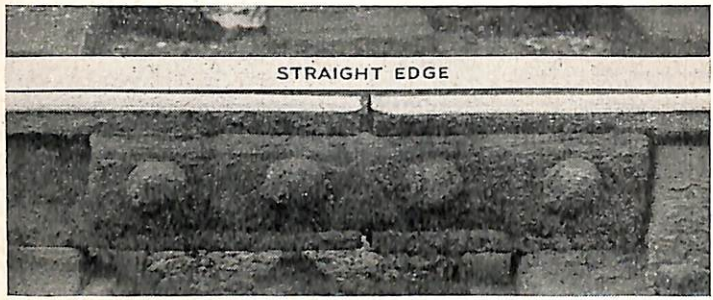

Fig. 1—Typical Worn Rail Joint before Shimming. Gap apparent between Straight Edge and Top Surface of Rail

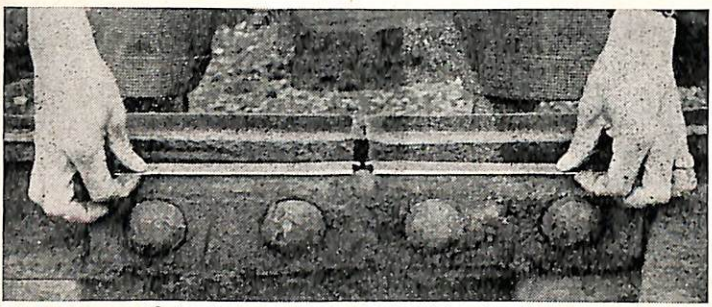

Fig. 2—Process of fitting Shim to Rail Joint shown in Fig. 1, after loosening Fishbolts

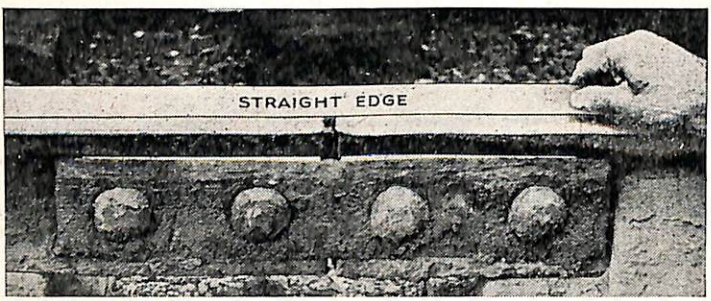

Fig. 3—Same Rail Joint after Shimming. Straight Edge shows Surface Level Restored

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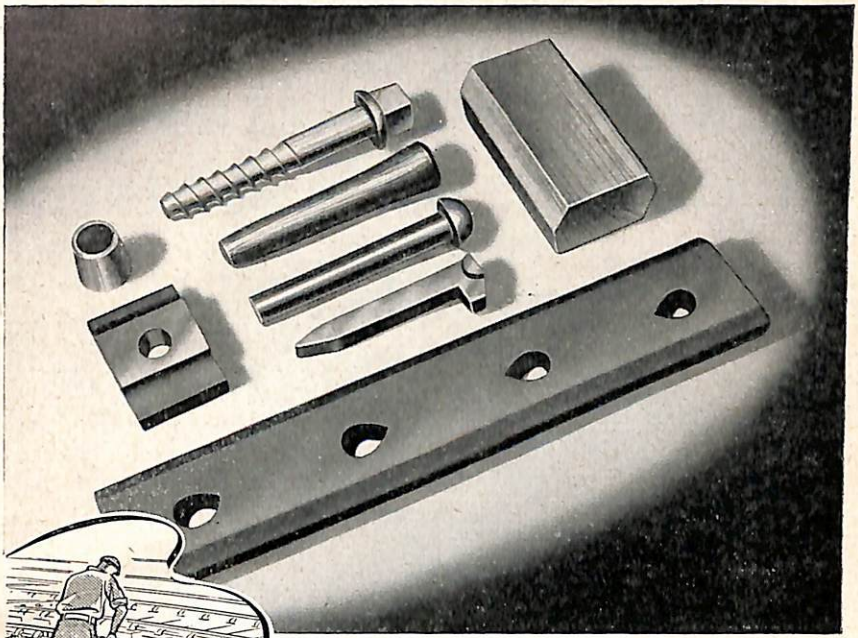

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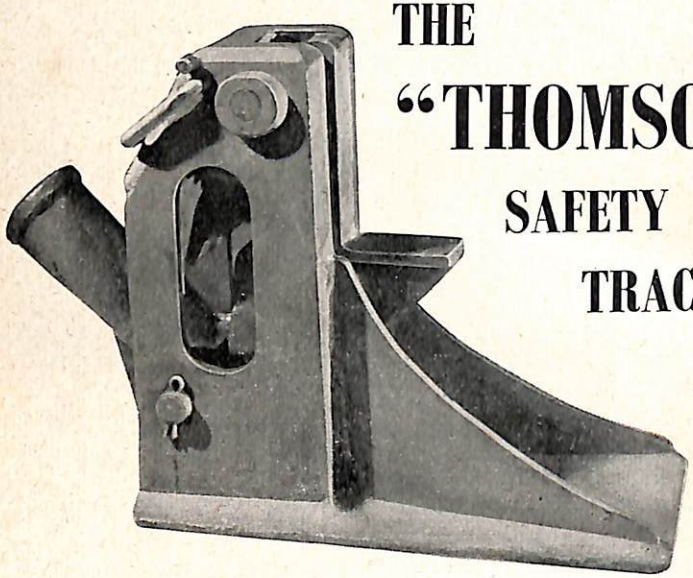

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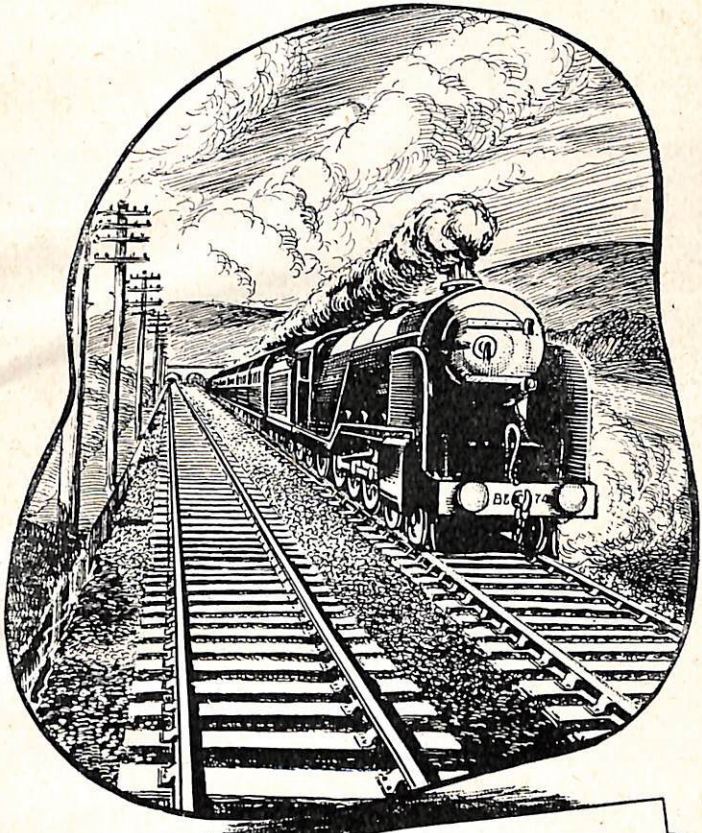

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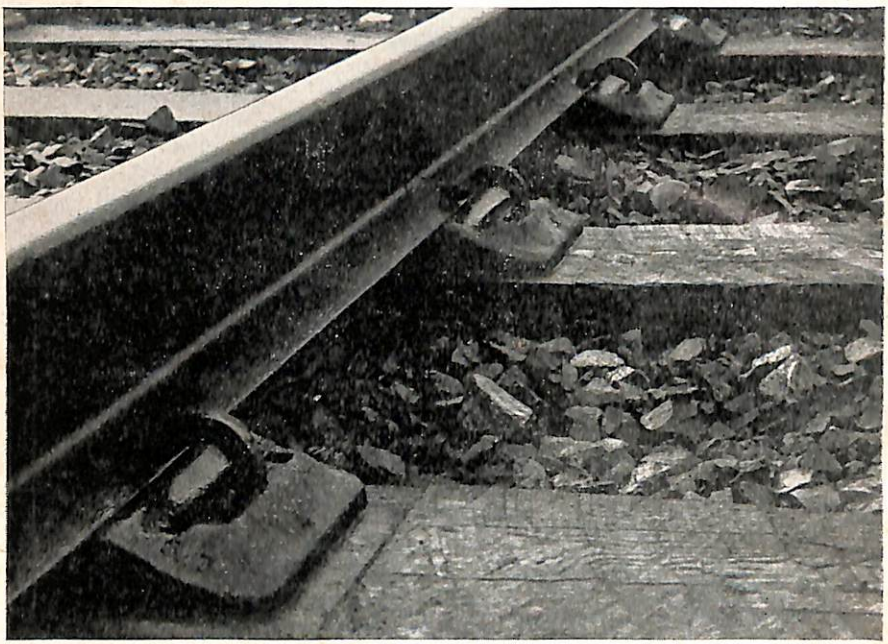

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